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ARTS AND SCIENCES.

VOL. XII.—No. I.

Mo. Bot. Garden,
1897.

CAMBRIDGE:
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1893.

I.

Catalogue of the Magnitudes of Southern Stars from 0° to —30° Declination, to the Magnitude 7.0 inclusive.

By EDWIN F. SAWYER.

Presented May 11, 1892.

INTRODUCTION.

The present work comprises a determination of the magnitudes of all stars as bright as the magnitude 7.0 in the belt from the equator to south declination 30°, together with some a few degrees outside of these limits. The work was undertaken in the beginning of 1882, and was substantially finished in 1887, although for the purpose of completeness many additional observations were made in 1888, and a few in 1889 and 1890. The total number of observations included is 13,654, and the number of stars in the Catalogue is 3,415, the average number of observations to each star being 4.0.

The general plan has been to observe every star three times. A reference to the Catalogue and the notes will show that there is only a small proportion where at least this number of observations has not been secured, while, on the contrary, more than half of the stars have been observed four times or more.

I was incited to undertake the work by a strong impression of the value attending a review of the ground gone over by Dr. Gould in the *Uranometria Argentina* early in the previous decade; at least so much of it as could be covered in this latitude. In its inception I had in mind to occupy a somewhat wider belt than that here included, and had, indeed, begun the series with observations extended to the northern boundary of the *Uranometria Argentina*, +10°. Afterwards it was deemed best to restrict myself to the region below the equator, in order to bring the undertaking more conveniently within the time at my disposal for the completion of the scheme within a reasonable period. The magnitudes here derived are founded upon the system of the *Uranometria Argentina;* and in fact

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the present Catalogue may be regarded as an independent revision of Dr. GOULD's work, within the described limits. With the exception of the stars α *Canis Majoris*, α *Scorpii*, and 102–3 (U. A.) *Orionis*, which were considered too difficult to obtain trustworthy observations of, it is believed that every star has been observed within the limits named, to the magnitude 7.0 inclusive. Many stars, generally fainter companions, whose positions are given in the U. A. Catalogue, but not there numbered, have also been included in the general work, although no attempt has been made to include all such cases, as these will receive attention in a later work. The observations were almost wholly discontinued during the years 1883 and 1885, owing to injury to the eyes from the trying nature of the work.

METHOD OF OBSERVATION.

The first step was to enter upon the charts of the *Uranometria Argentina* the numbers of the U. A. Catalogue. The stars were then observed in sequences, by ARGELANDER's method of step-estimations; each sequence comprising adjacent stars within a moderate range of magnitude. Each sequence comprised about ten stars; sometimes, in case of isolated groups, only five or six; and occasionally, where there were many stars in the vicinity, more than twenty. The brightest star in the region was first selected, then the next brighter, and so on down, other stars being afterwards inserted in their appropriate places.

The various differences of brightness were estimated in steps. When all stars in the neighborhood which could be conveniently observed had been included, a new sequence was begun, and so on. In those parts of the sequence near the limit of $7^{M}.0$, after all the U. A. stars had been included, any stars in the sky which were as bright as the fainter stars of the sequence were inserted in their proper places. During the first year's observations, in which nearly half of the whole work was done, an opera-glass was exclusively used. Afterwards a field-glass was employed for the fainter sequences, i. e. those involving the stars of 6^{M} or fainter. But no change of instrument was made during any sequence; that is, if a sequence was begun at about 5^{M} with the opera-glass, this glass was used to the lower limit of the sequence, even if it extended to below 6^{M}. The observations were consistently made with the instrument placed slightly out of focus, expanding the stars into disks of light; this method, after repeated trials, appearing to give the most trustworthy results, especially for colored stars. The observations were generally made during evenings free from moonlight, clouds, and haze, and between 6^{h} and 12^{h} mean time.

Method of Reduction.

The reduction of the sequences was performed graphically by plotting each sequence on squared paper, the U. A. magnitudes being used as ordinates, and the observed differences of brightness, expressed in steps, as abscissas. Thus, in the sequence $a\,2\,b\,3\,c\,1\,d\,2\,e\,3\,f$, the several stars would be indicated in the plotting by dots with the abscissas $a = 0$, $b = 2$, $c = 5$, $d = 6$, $e = 8$, and $f = 11$, and ordinates corresponding to the U. A. magnitudes for the several stars. The middle points between these dots, taken two and two, were then carefully inserted by measurement, and a straight line drawn so as to represent as well as possible all these points of bisection. The value of the ordinate, to the nearest half-tenth, was then read off, corresponding to the abscissa for each star. The magnitudes so deduced were then entered against the several stars in the record-book, and are the same as appear in the present Catalogue. The process thus described was uniformly pursued in the reduction of the sequences. There were, however, many observations made not in the form of regular sequences, consisting of comparisons of particular stars with several neighbors. Most of these observations were made in the final revision, in the case of insufficiently observed stars, or where large discordances gave rise to suspicion of variability. The magnitudes deduced in such cases were found simply by taking the means of the results of the separate comparisons.

Formation of the Catalogue.

The results of the observations were now collected to form the Catalogue. The stars were copied from the record-book upon cards. Each card contained the U. A. number of the star, its position and magnitude, and my separate observations. It was during this process that the stars which had been insufficiently observed were detected.

The cards were then arranged according to right ascension, and the results copied in the Catalogue. Those stars not contained in the U. A. Catalogue, although as bright as 7^{M}, were inserted in their proper places.

In the first column of the Catalogue is the current number of the star.

The second contains the U. A. Catalogue number.

The third contains the constellation.

In the fourth and fifth columns are the right ascensions and declinations for

the mean equinox of 1875.0, given, respectively, to the nearest tenth of a minute of time and the nearest minute of arc.

The sixth contains the number of observations.

The seventh contains the mean determined magnitude.

The eighth contains the U. A. magnitude.

The remaining columns contain the dates of the separate observations (month, day, and year), and the magnitudes.

Where there were more than three observations (6th column), the additional observations are given in the notes following the Catalogue.

Variable Stars.

During the progress of the work eight variable stars have been discovered, including two of the *Algol* type, namely: *U Ophiuchi* in 1881, *U Ceti* in 1885, *U Aquilæ* and *Y Sagittarii* in 1886, *R Canis Majoris* in 1887, *Y Ophiuchi* and *W Hydræ* in 1888, and (?) *Leporis* in 1891.

In addition, there are many cases of large discordance, notably numbers 53, 138, 384, 409, 415, 512, 514, 525, 543, 606, 609, 610, 611, 716, 757, 855, 944, 1107, 1229, 1234, 1253, 1357, 1449, 1513, 1562, 1646, 1890, 1931, 2002, 2078, 2219, 2231, 2285, 2499, 2506, 2542, 2580, 2582, 2610, 2632, 2641, 2668, 2670, 2781, 2822, 2880, 2931, 2932, 3023, 3077, 3368. I think it probable that variability will be found in some of these cases. These stars are worthy of special attention, but other work has prevented my systematically observing them.

There are yet other suspicious cases, mentioned in the notes accompanying the Catalogue.

Summary of Results.

The total number of stars contained in the Catalogue is 3,415, as already stated. Of these 3,347 are contained in Dr. Gould's Catalogue, the remaining 68 being those which were added on account of their being at least equal to 7^{M}. The number of stars in the present Catalogue, outside of the prescribed limit of the general plan, is 282, of which 206 lie north of the equator, and 76 south of -30° declination.

Table I. gives the distribution of the stars and the observations according to right ascension.

TABLE I.

Hour R. A.	No. of Stars.	No. of Observations.	Average No. of Observations.
0	171	613	3.6
1	158	628	4.0
2	163	668	4.1
3	143	606	4.2
4	129	528	4.1
5	181	736	4.1
6	195	750	3.9
7	169	663	4.0
8	143	524	3.7
9	135	562	4.2
10	132	485	3.7
11	113	402	3.6
12	120	442	3.7
13	111	431	3.8
14	120	493	4.1
15	113	484	4.3
16	116	496	4.2
17	125	517	4.1
18	161	690	4.3
19	142	566	4.0
20	163	663	4.0
21	148	602	4.1
22	135	547	4.0
23	129	558	4.3
	3,415	13,654	4.0

Table II. gives a classification of the stars according to the number of observations indicated in the first column.

TABLE II.

No. Observations.	No. Stars.
0	3
1	4
2	282
3	1221
4	1048
5	491
6	194
7	80
8	56
9	28
10 or more.	28

Table III. gives an analysis of the deviations (Gould — Sawyer) of the magnitudes of the two Catalogues, arranged according to the size of these differences, indicated in the first column. The last four columns give the number of stars according to the groupings indicated by the headings.

TABLE III.

Deviation.	Positive Deviation (G. — S.).		Negative Deviation (G. — S.).	
	$0^h - 12^h$	$12^h - 24^h$	$0^h - 12^h$	$12^h - 24^h$
0.00	400	343	—	—
0.05	256	233	251	204
0.10	233	189	231	192
0.15	81	81	87	96
0.20	49	57	75	55
0.25	27	13	35	23
0.30	9	11	15	24
0.35	1	3	10	5
0.40	3	1	4	5
0.45	0	0	5	1
0.50	0	0	3	0
0.55	1	1	3	0
0.60	0	0	0	1
	1060	932	719	606

By means of this table we find that the average difference between the magnitudes assigned by this Catalogue and that of Dr. GOULD, is $\pm 0^{M}.088$. Assuming the magnitudes of the two catalogues to have an equal degree of precision, we have $\pm 0^{M}.059$ as the value of the average error of a single determination of magnitude in each Catalogue. This of course includes, besides the accidental error, the effect of systematic difference.

CATALOGUE.

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U.A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
1	9	*Ceti*	0 0.4	−23 48	3	6.2	6.3	11 9 84	6.2	10 22 86	6.2	10 19 87	6.2
2	10	"	0.9	18 5	6	6.2	6.3	12 29 82	6.35	10 21 86	6.1	11 18 86	6.5
3	49	*Sculptoris*	1.0	26 3	3	6.9	6.9	9 26 84	6.9	10 22 86	7.0	12 2 88	6.8
4	65	*Piscium*	1.3	3 15	4	6.5	6.5	1 9 82	6.5	12 29 82	6.55	10 13 84	6.6
5	11	*Ceti*	1.4	23 12	3	6.0	5.9	11 9 84	6.0	10 22 86	5.95	11 7 88	6.05
6	66	*Piscium*	1.8	3 9	4	6.5	6.4	1 9 82	6.4	12 29 82	6.4	10 13 84	6.6
7	12	*Ceti*	1.9	9 31	4	6.3	6.2	12 29 82	6.2	10 23 86	6.4	11 28 86	6.35
8	13	"	2.2	18 16	4	6.45	6.2	12 29 82	6.35	10 21 86	6.4	10 19 87	6.5
9	51	*Sculptoris*	3.0	28 41	4	5.4	5.5	9 26 84	5.3	10 21 86	5.4	10 19 87	5.4
10	67	*Piscium*	3.9	5 57	4	6.1	6.1	10 13 84	6.2	10 21 86	6.0	10 19 87	6.05
11	14	*Ceti*	4.3	13 16	4	6.0	5.9	1 3 83	6.0	10 23 86	6.0	11 7 88	6.0
12	..	*Piscium*	4.8	4 1	4	6.9	..	12 29 82	6.8	10 18 84	6.9	10 22 86	6.9
13	15	*Ceti*	4.9	16 9	6	4.85	5.1	12 29 82	5.0	10 21 86	5.0	11 18 86	4.75
14	16	"	5.2	19 18	3	7.0	7.0	12 29 82	7.0	10 22 86	6.95	10 23 86	7.0
15	52	*Sculptoris*	5.2	28 30	3	5.6	5.4	9 26 84	5.55	10 21 86	5.6	12 2 88	5.7
16	17	*Ceti*	5.7	14 30	4	6.8	6.8	1 3 83	6.7	10 23 86	6.9	10 19 87	6.75
17	18	"	5.8	18 38	2	5.5	5.4	12 29 82	5.5	10 21 86	5.5	.. .. ..	...
18	19	"	6.7	23 10	2	7.0	6.9	11 9 84	7.0	10 22 86	7.0	.. .. ..	...
19	20	"	7.4	23 55	2	7.0	7.0	11 9 84	7.0	10 22 86	7.0	.. .. ..	...
20	55	*Sculptoris*	7.4	26 43	3	6.2	6.0	9 26 84	6.2	10 22 86	6.1	10 19 87	6.25
21	56	"	7.4	26 59	4	6.25	6.3	9 26 84	6.3	10 22 86	6.2	10 19 87	6.2
22	69	*Piscium*	7.4	+ 0 41	3	6.9	7.0	1 9 82	6.95	11 27 86	6.9	10 19 87	6.9
23	68	"	8.0	− 2 54	9	7.25	7.0	1 9 82	7.1	12 29 82	7.2	10 18 84	7.1
24	21	*Ceti*	8.0	21 53	4	6.95	7.0	11 9 84	6.9	10 22 86	6.95	10 23 86	7.0
25	22	"	8.1	8 29	4	5.5	5.4	12 29 82	5.5	10 21 86	5.4	10 23 86	5.5
26	23	"	8.1	15 7	9	7.0	7.0	1 3 83	7.3	10 23 86	6.9	11 15 86	7.1
27	..	*Piscium*	8.2	+ 0 36	3	6.9	7.1	1 9 82	6.95	11 27 86	6.9	10 19 87	6.9
28	24	*Ceti*	8.3	−15 30	3	6.8	6.8	1 3 83	6.7	10 23 86	6.9	11 9 87	6.85
29	25	"	8.3	19 38	8	4.65	4.3	12 29 82	4.1	10 21 86	4.6	11 15 86	4.9
30	26	"	8.5	14 52	3	6.9	6.9	1 3 83	6.9	10 23 86	6.9	10 19 87	6.9
31	27	"	8.5	10 16	5	5.7	5.9	12 29 82	5.9	10 23 86	5.7	10 19 87	5.7
32	..	"	8.5	3 43	4	6.9	..	12 29 82	6.8	10 18 84	6.9	10 22 86	6.9
33	70	*Piscium*	8.5	+ 8 8	4	5.9	5.8	1 7 82	5.7	1 9 82	5.9	11 27 86	6.0
34	71	"	9.2	5 9	3	7.0	7.0	1 9 82	7.05	11 27 86	7.0	12 6 88	7.0
35	72	"	9.5	3 33	4	6.85	6.8	11 27 86	6.9	12 21 86	6.75	11 12 87	6.85
36	58	*Sculptoris*	9.8	−32 8	2	6.0	5.9	11 9 84	6.0	10 22 86	6.0	.. .. ..	...
37	73	*Piscium*	10.2	+ 7 33	3	6.25	6.3	1 9 82	6.25	11 27 86	6.2	12 6 88	6.35
38	74	"	10.3	1 9	5	7.1	7.0	1 9 82	7.2	11 27 86	7.0	12 21 86	7.2
39	28	*Ceti*	10.4	−20 54	4	6.6	6.5	11 9 84	6.6	10 22 86	6.5	10 23 86	6.65
40	75	*Piscium*	11.0	+ 8 11	4	6.9	6.9	1 9 82	6.8	11 27 86	6.95	11 17 87	7.0
41	29	*Ceti*	11.2	−19 45	4	6.7	6.6	12 29 82	6.6	10 22 86	6.8	10 23 86	6.7
42	76	*Piscium*	11.4	+ 1 0	3	6.45	6.4	1 9 82	6.45	11 27 86	6.4	11 7 88	6.5
43	..	"	11.4	− 2 34	5	7.05	7.1	1 9 82	7.0	12 29 82	7.05	10 18 84	7.0
44	30	*Ceti*	0 11.5	14 9	4	6.6	6.7	1 3 83	6.6	10 23 86	6.5	11 9 87	6.6

No.	U. A. No.	Name.	1875.		No. Obs.	Mag.		Separate Observations.					
			R. A.	Decl.		Mean Obs'd.	U. A.	Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
45	77	*Piscium*	0 11.7	+ 3 6	3	6.9	6.9	1 9 82	6.8	11 27 86	6.9	12 6 88	6.95
46	..	*Piscium*	11.9	− 2 43	4	7.15	7.2	1 9 82	7.1	12 29 82	7.2	10 18 84	7.2
47	31	*Ceti*	12.0	21 50	3	6.6	6.6	11 9 84	6.6	10 22 86	6.5	10 23 86	6.65
48	32	"	12.2	8 45	3	6.65	6.8	12 29 82	6.6	10 23 86	6.75	11 9 87	6.65
49	33	"	13.1	9 31	5	3.5	3.5	11 9 84	3.45	11 11 84	3.3	10 21 86	3.5
50	34	"	13.2	7 55	3.	6.95	6.8	12 29 82	7.0	10 23 86	6.85	11 9 87	7.0
51	78	*Piscium*	13.5	3 11	4	6.95	7.0	1 9 82	7.0	12 29 82	6.9	10 18 84	7.0
52	79	"	13.7	+ 5 36	3	6.95	7.0	1 9 82	6.9	11 27 86	6.95	12 6 88	6.95
53	80	"	13.8	2 20	5	7.35	7.0	1 9 82	7.0	11 27 86	7.4	12 25 86	7.5
54	81	"	14.2	7 30	4	5.55	5.3	1 7 82	5.3	11 27 86	5.55	11 17 87	5.7
55	35	*Ceti*	14.5	−24 19	3	6.75	7.0	11 9 84	6.8	10 22 86	6.7	11 7 88	6.7
56	82	*Piscium*	14.7	3 36	4	6.9	7.0	1 9 82	6.9	12 29 82	6.8	10 18 84	7.0
57	62	*Sculptoris*	15.2	29 40	4	5.3	5.3	11 9 84	5.4	10 22 86	5.25	11 9 87	5.4
58	36	*Ceti*	15.4	20 45	.	var.	6.5	11 9 84	7.0	.. .. ..	...	.. .. ..	...
59	83	*Piscium*	15.9	+ 5 53	1	...	6.7	1 9 82	6.8	.. .. ..	...	.. .. ..	...
60	37	*Ceti*	16.5	−12 54	3	6.35	6.4	1 3 83	6.3	10 23 86	6.4	11 7 88	6.4
61	38	"	16.7	16 38	3	6.9	7.0	11 9 84	6.8	10 22 86	7.0	11 9 87	6.9
62	65	*Sculptoris*	17.0	31 44	3	6.5	6.6	11 9 84	6.4	10 22 86	6.6	11 9 87	6.5
63	66	"	17.1	30 32	3	6.85	6.8	11 9 84	6.9	10 22 86	6.85	12 2 88	6.85
64	84	*Piscium*	18.1	2 55	4	6.45	6.4	1 9 82	6.55	12 29 82	6.4	10 18 84	6.3
65	85	"	19.0	+ 1 15	4	5.8	5.9	1 9 82	5.7	11 27 86	5.9	11 17 87	5.9
66	86	"	19.3	7 0	4	6.9	6.9	1 9 82	6.8	11 27 86	6.95	11 17 87	6.9
67	68	*Sculptoris*	19.5	−28 24	3	6.85	6.8	11 9 84	6.9	10 22 86	6.85	12 2 88	6.85
68	87	*Piscium*	19.9	+ 3 8	4	6.6	6.8	1 9 82	6.7	11 27 86	6.6	11 17 87	6.5
69	39	*Ceti*	20.1	−19 23	3	6.75	6.7	11 9 84	6.7	10 22 86	6.8	10 23 86	6.7
70	40	"	20.2	0 45	3	6.35	6.2	1 9 82	6.3	10 25 86	6.4	11 27 86	6.4
71	41	"	20.7	5 42	3	7.0	7.0	11 11 84	7.0	10 25 86	7.1	11 9 87	6.95
72	69	*Sculptoris*	21.0	26 14	3	6.3	6.5	11 8 84	6.3	10 22 86	6.35	1 19 89	6.2
73	70	"	21.1	28 56	4	6.8	6.8	11 9 84	6.7	10 22 86	6.85	11 9 87	6.85
74	42	*Ceti*	21.3	20 50	3	6.75	6.8	11 9 84	6.7	10 22 86	6.8	10 23 86	6.7
75	72	*Sculptoris*	22.0	29 44	3	6.7	6.7	11 9 84	6.7	10 22 86	6.6	12 2 88	6.85
76	43	*Ceti*	22.1	21 1	3	6.65	6.4	11 9 84	6.6	10 22 86	6.7	10 23 86	6.6
77	44	"	22.2	11 56	4	7.0	7.0	11 9 84	7.0	10 23 86	7.15	11 9 87	6.95
78	73	*Sculptoris*	22.2	29 59	3	6.85	6.9	11 9 84	6.9	10 22 86	6.85	12 2 88	6.85
79	45	*Ceti*	23.1	4 10	5	6.9	7.0	1 9 82	6.8	10 25 86	6.85	11 12 87	6.9
80	46	"	23.3	3 32	3	6.9	6.9	1 9 82	6.9	10 25 86	6.85	11 12 87	6.9
81	47	"	23.5	15 33	3	6.15	6.2	11 9 84	6.2	10 22 86	6.15	12 4 88	6.15
82	48	"	23.7	4 39	3	6.05	6.0	1 11 82	6.1	11 11 84	6.1	10 25 86	6.0
83	89	*Piscium*	23.7	+ 4 10	2	6.6	6.5	1 9 82	6.6	12 21 86	6.6	.. .. ..	...
84	49	*Ceti*	24.1	−24 29	3	5.25	5.2	11 8 84	5.2	10 22 86	5.3	12 4 88	5.3
85	50	"	24.7	10 47	4	6.7	6.8	11 9 84	6.8	10 23 86	6.6	11 9 87	6.65
86	51	"	25.3	2 29	3	6.85	6.8	1 9 82	6.85	10 25 86	6.85	11 12 87	6.85
87	90	*Piscium*	26.0	+ 6 16	6	5.4	5.8	1 7 82	5.5	1 11 82	5.4	12 19 86	5.4
88	75	*Sculptoris*	26.4	−26 3	3	6.85	6.9	11 8 84	6.8	10 12 86	6.9	12 2 88	6.85
89	..	*Ceti*	27.2	1 20	4	7.0	..	11 12 87	7.0	11 17 87	7.0	12 23 89	7.0
90	77	*Sculptoris*	27.5	30 15	4	5.8	5.8	11 9 84	5.6	10 22 86	5.8	11 9 87	5.9
91	52	*Ceti*	28.1	5 14	4	6.85	6.8	1 11 82	6.9	11 11 84	6.7	10 25 86	6.9
92	53	"	28.1	7 11	2	6.7	6.8	11 11 84	6.7	10 25 86	6.7	.. .. ..	...
93	54	"	28.8	4 17	3	5.6	5.7	1 11 82	5.6	11 11 84	5.6	10 25 86	5.65
94	55	"	29.1	1 12	5	5.95	6.0	1 9 82	6.0	10 25 86	5.85	11 27 86	6.1
95	56	"	29.6	6 15	3	6.65	6.7	11 11 84	6.6	10 25 86	6.7	11 7 88	6.6
96	57	"	29.8	15 40	2	6.6	6.7	11 9 84	6.6	10 22 86	6.6	.. .. ..	...
97	58	"	0 29.9	23 32	3	6.15	6.1	11 8 84	6.1	10 22 86	6.2	12 4 88	6.15

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag
			h. m.	° ′									
98	59	*Ceti*	0 30.9	−25 27	4	5.8	5.8	11 8 84	5.7	10 22 86	5.7	12 4 88	5.9
99	92	*Piscium*	31.1	+ 2 27	3	6.85	6.8	1 11 82	6.8	11 27 86	6.75	12 6 88	6.95
100	60	*Ceti*	31.7	− 1 11	4	6.8	6.8	1 9 82	6.8	10 25 86	6.85	11 12 87	6.9
101	61	"	32.3	20 59	9	6.7	7.0	1 10 85	7.1	10 22 86	6.6	11 18 86	6.7
102	80	*Sculptoris*	32.4	30 7	3	6.65	6.6	11 9 84	6.7	10 22 86	6.6	12 22 88	6.6
103	81	"	32.6	25 48	3	6.65	6.5	11 8 84	6.7	10 22 86	6.6	12 4 88	6.7
104	62	*Ceti*	33.4	11 50	3	6.85	6.9	12 29 82	6.8	10 23 86	6.9	11 27 86	6.85
105	63	"	34.2	17 12	2	6.8	6.7	11 9 84	6.8	10 22 86	6.8	.. .. ..	...
106	64	"	34.2	24 29	3	6.35	6.3	11 8 84	6.4	10 22 86	6.35	12 4 88	6.35
107	65	"	34.3	5 2	3	6.05	6.0	1 11 82	6.1	11 11 84	5.9	10 25 86	6.1
108	..	"	34.5	7 54	5	6.8	..	11 11 84	6.7	10 25 86	6.9	11 12 87	6.95
109	82	*Sculptoris*	35.4	25 53	2	6.7	6.8	11 8 84	6.7	10 22 86	6.7	.. .. ..	...
110	66	*Ceti*	35.9	12 29	3	6.85	7.0	12 29 82	6.8	10 23 86	6.9	11 27 86	6.9
111	67	"	36.6	10 36	3	6.7	6.6	12 29 82	6.7	10 23 86	6.7	11 27 86	6.7
112	68	"	36.7	4 33	3	7.1	7.0	1 11 82	7.1	11 11 84	7.1	11 12 87	7.15
113	69	"	37.0	7 1	6	7.35	7.0	11 11 84	7.3	10 25 86	7.4	11 18 86	7.35
114	70	"	37.3	18 40	4	2.35	2.3	11 18 86	2.45	11 22 86	2.4	11 24 86	2.35
115	71	"	37.6	12 41	3	6.3	6.2	12 29 82	6.3	10 23 86	6.4	11 27 86	6.25
116	72	"	37.9	11 17	3	5.05	5.1	12 29 82	5.05	10 23 86	5.0	11 27 86	5.1
117	73	"	38.6	22 42	4	5.3	5.3	1 3 83	5.3	11 8 84	5.3	10 22 86	5.4
118	74	"	39.0	5 19	3	6.45	6.6	1 11 82	6.5	11 11 84	6.5	10 25 86	6.4
119	75	"	39.2	13 33	5	6.3	6.3	12 29 82	6.3	10 23 86	6.4	11 27 86	6.15
120	76	"	39.5	17 6	2	6.6	6.6	11 9 84	6.6	10 22 86	6.6	.. .. ..	...
121	77	"	40.0	23 12	4	5.75	5.8	1 3 83	5.6	11 8 84	5.8	10 22 86	5.8
122	85	*Sculptoris*	40.5	30 53	3	6.6	6.5	11 9 84	6.6	10 22 86	6.55	12 22 88	6.65
123	94	*Piscium*	40.9	+ 6 4	4	6.05	6.2	1 7 82	6.0	12 21 86	6.1	12 6 88	6.2
124	78	*Ceti*	41.5	−18 45	3	6.25	6.1	11 9 84	6.3	10 22 86	6.2	12 4 88	6.2
125	86	*Sculptoris*	41.6	32 2	3	6.7	6.8	11 9 84	6.6	10 22 86	6.8	11 9 87	6.7
126	79	*Ceti*	41.8	22 24	5	5.65	5.8	1 3 83	5.8	11 8 84	5.6	10 22 86	5.6
127	96	*Piscium*	41.8	+ 4 39	4	5.85	5.9	1 7 82	5.8	12 19 86	5.85	12 21 86	5.85
128	95	"	41.8	6 37	3	6.25	6.0	1 7 82	6.25	12 21 86	6.25	12 6 88	6.2
129	97	"	42.2	6 54	3	4.6	4.4	1 9 82	4.6	1 11 82	4.6	12 21 86	4.6
130	87	*Sculptoris*	42.6	−29 11	4	6.6	6.5	11 9 84	6.6	10 22 86	6.55	12 4 88	6.7
131	80	*Ceti*	43.1	24 49	4	6.15	6.1	1 3 83	6.1	11 8 84	6.2	10 22 86	6.1
132	81	"	43.2	14 14	4	6.0	5.9	12 29 82	6.05	10 23 86	6.0	11 27 86	5.95
133	..	"	43.2	23 54	3	7.15	7.1	1 3 83	7.1	11 8 84	7.1	10 22 86	7.2
134	82	"	43.4	24 3	7	6.35	6.5	1 3 83	6.4	11 8 84	6.4	10 23 86	6.1
135	83	"	43.5	0 54	3	7.0	7.0	1 11 82	7.0	10 25 86	6.9	12 4 88	7.05
136	84	"	43.9	11 19	3	5.45	5.5	12 29 82	5.5	10 23 86	5.4	11 27 86	5.4
137	85	"	44.8	5 43	4	6.9	7.0	1 11 82	6.9	11 11 84	6.8	10 25 86	7.0
138	98	*Piscium*	44.9	+ 2 43	8	6.5	6.7	1 11 82	6.7	12 21 86	6.35	12 25 86	6.25
139	86	*Ceti*	45.0	−10 5	2	6.8	6.9	11 11 84	6.8	10 23 86	6.8	.. .. ..	..
140	87	"	45.2	3 49	2	7.0	7.0	1 11 82	7.0	10 25 86	7.0	.. .. ..	..
141	88	"	46.5	24 41	4	5.9	5.7	1 3 83	5.8	11 8 84	5.9	10 22 86	5.8
142	89	"	46.6	1 49	4	5.2	5.2	1 11 82	5.0	11 27 86	5.2	2 13 88	5.3
143	89	*Sculptoris*	46.9	31 2	3	6.75	6.8	11 9 84	6.7	10 22 86	6.8	12 22 88	6.75
144	90	*Ceti*	47.1	25 27	4	6.65	6.6	1 3 83	6.8	11 8 84	6.6	10 22 86	6.65
145	91	"	47.3	5 12	3	6.65	6.5	1 11 82	6.7	11 11 84	6.7	10 25 86	6.6
146	92	"	48.0	9 25	2	6.3	6.2	11 11 84	6.3	10 23 86	6.3	.. .. ..	..
147	93	"	49.4	8 1	2	6.1	6.0	11 11 84	6.1	10 23 86	6.1	.. .. ..	..
148	94	"	49.8	11 57	3	5.7	5.7	12 29 82	5.65	10 23 86	5.8	11 27 86	5.7
149	90	*Sculptoris*	49.9	28 27	3	6.3	6.3	11 9 84	6.3	10 22 86	6.3	12 22 88	6.3
150	95	*Ceti*	0 50.4	3 24	3	6.9	6.9	1 11 82	6.9	10 25 86	7.0	12 4 88	6.8

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date	Mag.
			h. m.	° ′									
151	. .	*Sculptoris*	0 50.7	−26 2	2	6.8	. .	11 9 84	6.8	10 22 86	6.8	. . . . . .	. .
152	96	*Ceti*	51.5	2 27	3	6.75	6.8	1 11 82	6.75	10 25 86	6.7	12 4 88	6.85
153	97	"	51.5	19 41	3	7.05	7.0	11 9 84	7.0	10 22 86	7.1	11 12 87	7.1
154	. .	"	51.9	16 22	3	7.0	7.0	11 9 84	7.0	10 23 86	6.9	12 2 88	7.05
155	99	*Piscium*	51.9	+ 6 10	3	6.7	6.8	1 7 82	6.7	12 19 86	6.7	12 21 86	6.7
156	91	*Sculptoris*	52.1	−26 33	2	7.0	7.0	11 9 84	7.0	10 22 86	7.0	. . . . . .	. .
157	98	*Ceti*	52.4	6 33	3	6.7	6.6	11 11 84	6.7	10 23 86	6.6	12 4 88	6.75
158	99	"	52.5	12 3	4	5.95	5.9	12 29 82	6.05	10 23 86	6.0	11 27 86	5.9
159	92	*Sculptoris*	52.6	30 2	3	4.25	4.2	10 23 86	4.3	12 20 86	4.3	12 22 88	4.1
160	100	*Piscium*	53.4	+ 5 49	3	6.4	6.2	1 7 82	6.4	12 19 86	6.4	12 21 86	6.45
161	100	*Ceti*	54.3	− 2 20	4	7.05	7.0	1 11 82	7.1	10 25 86	7.0	11 17 87	7.1
162	101	"	55.4	16 56	5	6.6	6.8	11 9 84	6.5	10 28 86	6.7	11 18 86	6.5
163	103	*Piscium*	56.5	+ 7 13	3	4.45	4.2	12 19 86	4.45	12 21 86	4.45	12 6 88	4.4
164	102	*Ceti*	56.7	− 5 30	3	5.8	5.8	1 11 82	5.85	11 9 84	5.8	10 23 86	5.7
165	97	*Sculptoris*	57.3	30 12	4	6.4	6.5	11 9 84	6.5	10 22 86	6.3	11 9 87	6.4
166	104	*Piscium*	57.3	+ 6 6	3	6.8	7.0	1 7 82	6.9	12 19 86	6.7	12 21 86	6.8
167	103	*Ceti*	57.4	0 42	4	5.85	5.9	1 7 82	5.9	11 24 86	5.9	11 26 86	5.8
168	105	*Piscium*	58.4	4 59	3	6.35	5.9	1 7 82	6.4	12 19 86	6.3	12 21 86	6.8
169	104	*Ceti*	59.4	−10 39	5	6.3	6.5	11 11 84	6.2	10 23 86	6.5	11 28 86	6.25
170	106	*Piscium*	59.4	+ 4 15	3	6.15	5.9	1 7 82	6.25	12 19 86	6.1	12 21 86	6.1
171	105	*Ceti*	0 59.8	−10 31	3	5.7	5.7	11 11 84	5.6	10 23 86	5.7	12 4 88	5.75
172	106	"	1 0.1	24 40	2	6.4	6.3	11 14 84	6.4	10 22 86	6.4	. . . . . .	. .
173	107	*Piscium*	0.4	+ 7 59	6	6.8	6.9	1 27 82	6.6	12 21 86	6.9	12 25 86	6.65
174	107	*Ceti*	0.8	− 2 24	3	6.95	7.0	1 11 82	7.0	1 30 82	6.9	11 18 86	7.0
175	108	"	1.2	24 40	3	6.35	6.4	11 14 84	6.3	10 22 86	6.4	12 22 88	6.4
176	109	"	1.5	10 27	3	5.95	5.8	11 11 84	5.9	10 23 86	6.0	12 22 88	6.0
177	110	"	1.6	+ 1 21	7	6.5	6.3	1 7 82	6.2	11 24 86	6.6	11 26 86	6.7
178	108	*Piscium*	1.8	9 14	4	6.9	7.0	1 27 82	6.7	12 21 86	6.95	11 17 87	6.95
179	109	"	1.9	4 59	5	5.6	5.5	1 7 82	5.4	1 27 82	5.8	12 19 86	5.65
180	111	*Ceti*	2.3	−10 51	7	3.25	3.5	11 9 84	3.1	11 11 84	3.2	10 23 86	3.2
181	110	*Piscium*	2.4	+ 9 4	4	7.05	7.0	1 27 82	7.05	12 21 86	7.1	11 17 87	7.05
182	112	*Ceti*	3.9	− 9 34	7	6.6	6.5	11 11 84	6.5	11 17 84	6.5	10 23 86	6.7
183	113	"	4.1	+ 1 47	5	6.25	6.1	1 7 82	6.1	11 24 86	6.3	11 26 86	6.8
184	111	*Piscium*	4.4	8 53	4	7.1	7.0	1 27 82	7.2	12 21 86	7.15	11 17 87	7.05
185	112	"	4.9	9 38	4	6.55	6.6	1 27 82	6.4	12 21 86	6.6	11 17 87	6.6
186	114	*Ceti*	5.4	− 2 55	3	6.35	6.1	1 30 82	6.2	11 18 86	6.35	11 17 87	6.4
187	115	"	6.1	+ 1 49	5	6.55	6.3	1 7 82	6.4	11 24 86	6.6	11 26 86	6.7
188	116	"	6.5	− 7 27	3	6.9	6.9	11 11 84	6.8	11 17 84	7.0	10 23 86	6.9
189	113	*Piscium*	7.2	+ 6 55	3	4.85	4.8	1 27 82	5.0	12 19 86	4.8	12 21 86	4.8
190	117	*Ceti*	7.8	−14 8	3	6.95	7.0	11 11 84	6.9	10 23 86	6.95	12 24 88	6.95
191	118	"	8.1	8 36	3	5.15	5.3	11 11 84	5.2	10 23 86	5.1	12 24 88	5.1
192	114	*Piscium*	8.2	+ 6 20	4	6.1	6.2	1 27 82	6.1	12 21 86	6.2	12 25 86	6.1
193	119	*Ceti*	8.4	− 1 39	3	5.85	5.8	1 30 82	5.8	11 18 86	5.9	12 4 88	5.8
194	120	"	9.2	+ 0 15	5	6.55	6.7	1 30 82	6.6	11 24 86	6.5	11 26 86	6.45
195	121	"	10.3	− 3 10	3	5.45	5.5	1 30 82	5.5	11 18 86	5.4	12 4 88	5.5
196	122	"	10.6	2 56	3	6.85	6.9	1 30 82	6.9	11 18 86	6.8	12 4 88	6.85
197	123	"	11.4	8 19	3	6.9	7.0	11 11 84	6.8	11 17 84	7.0	10 23 86	6.9
198	115	*Piscium*	11.4	+ 2 57	3	5.0	5.2	1 27 82	5.1	12 19 86	4.95	12 21 86	5.0
199	124	*Ceti*	13.4	− 1 10	3	6.05	6.1	1 30 82	6.1	11 18 86	6.05	12 4 88	6.0
200	125	"	13.8	10 32	3	6.55	6.6	1 3 83	6.6	10 23 86	6.55	12 2 88	6.55
201	126	"	13.8	16 28	3	6.65	6.7	11 11 84	6.6	10 23 86	6.7	12 24 88	6.65
202	127	"	14.2	3 54	3	6.35	6.3	1 30 82	6.4	11 18 86	6.35	12 4 88	6.35
203	128	"	1 14.3	11 54	4	6.2	6.3	1 3 83	6.1	10 23 86	6.25	11 27 86	6.2

No.	U. A. No.	Name	1875. R. A.	1875. Decl.	No Obs	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
204	129	*Ceti*	1 14.5	−14 33	3	6.95	7.0	11 11 84	6.9	10 23 86	6.95	12 24 88	6.95
205	130	"	15.0	6 49	7	6.8	6.6	2 8 82	6.7	11 11 84	7.0	11 17 84	6.7
206	131	"	16.2	+ 1 5	5	6.55	6.8	1 30 82	6.6	11 24 86	6.5	11 26 86	6.45
207	132	"	16.2	− 1 6	3	6.8	6.7	1 30 82	6.8	11 18 86	6.8	12 4 88	6.8
208	133	"	16.5	19 44	3	6.4	6.4	11 11 84	6.4	10 23 86	6.35	12 22 88	6.4
209	134	"	17.6	25 0	3	6.65	6.5	11 11 84	6.6	12 20 86	6.7	12 22 88	6.65
210	135	"	17.7	8 39	3	6.8	6.9	11 14 84	6.7	10 23 86	6.9	11 12 87	6.8
211	109	*Sculptoris*	17.7	31 36	4	6.3	6.0	11 14 84	6.3	10 23 86	6.3	11 9 87	6.3
212	136	*Ceti*	17.8	8 50	7	3.5	3.2	11 9 84	3.45	11 11 84	3.6	10 23 86	3.5
213	137	"	18.1	7 34	5	5.95	5.9	2 8 82	6.05	11 11 84	5.9	10 23 86	6.0
214	110	*Sculptoris*	18.4	32 28	3	6.8	6.8	11 14 84	6.7	10 23 86	6.75	12 28 88	6.9
215	138	*Ceti*	18.5	3 30	3	6.4	6.4	1 30 82	6.4	11 18 86	6.45	12 4 88	6.4
216	139	"	18.5	16 19	3	6.3	6.4	11 11 84	6.3	10 23 86	6.35	12 24 88	6.2
217	140	"	18.7	6 36	7	6.55	6.5	2 8 82	6.6	11 11 84	6.8	11 17 84	6.4
218	116	*Piscium*	19.2	+ 2 19	4	6.85	7.0	1 30 82	6.8	11 24 86	6.8	11 26 86	6.95
219	141	*Ceti*	19.5	−15 15	3	5.15	5.1	1 3 83	5.1	10 23 86	5.25	11 26 86	5.15
220	142	"	19.5	4 37	33	6.65	var.	1 30 82	6.6	11 28 86	6.65	2 6 88	6.75
221	143	"	19.7	9 9	4	6.9	7.0	11 14 84	6.8	10 23 86	7.0	11 12 87	7.05
222	144	"	20.1	1 3	3	6.6	6.6	1 30 82	6.6	11 18 86	6.55	12 4 88	6.6
223	117	*Piscium*	20.4	+ 2 53	5	6.55	6.6	1 30 82	6.6	11 24 86	6.6	11 26 86	6.45
224	145	*Ceti*	20.7	−13 42	5	5.5	5.5	1 3 83	5.7	10 23 86	5.45	11 18 86	5.5
225	...	*Sculptoris*	20.7	30 56	3	7.3	7.5	11 14 84	7.3	10 23 86	7.4	12 28 88	7.2
226	146	*Ceti*	21.2	9 57	3	6.9	6.7	11 14 84	6.9	10 23 86	6.9	12 2 88	6.9
227	112	*Sculptoris*	21.3	30 53	4	6.9	6.9	11 14 84	7.1	10 23 86	6.85	11 9 87	6.85
228	147	*Ceti*	21.4	21 0	5	7.0	6.9	11 11 84	6.9	10 23 86	6.9	12 22 89	7.1
229	148	"	21.4	22 59	3	6.6	6.6	11 11 84	6.6	10 23 86	6.6	12 22 88	6.65
230	149	"	21.5	11 33	5	6.35	6.2	1 3 83	6.4	10 23 86	6.25	11 18 86	6.4
231	150	"	21.7	2 41	3	6.8	6.8	1 30 82	6.8	11 18 86	6.8	12 4 88	6.8
232	118	*Piscium*	21.8	+ 7 19	3	6.05	5.9	2 8 82	6.1	12 21 86	6.0	12 24 88	6.1
233	151	*Ceti*	22.0	−22 41	3	6.6	6.7	11 11 84	6.6	10 23 86	6.6	12 22 88	6.65
234	152	"	22.1	12 54	3	6.75	6.8	1 3 83	6.8	10 23 86	6.7	11 27 86	6.75
235	119	*Piscium*	22.5	+ 6 39	4	6.55	6.6	2 8 82	6.45	12 21 86	6.6	11 17 87	6.45
236	153	*Ceti*	22.9	−18 35	3	6.6	6.5	11 11 84	6.7	10 23 86	6.5	10 12 87	6.6
237	154	"	22.9	25 27	3	6.95	6.9	11 11 84	6.9	10 23 86	6.95	12 22 88	6.95
238	155	"	23.3	10 8	3	6.9	6.9	11 14 84	6.9	10 23 86	6.9	12 2 88	6.95
239	...	"	23.5	13 52	5	7.0	..	1 3 83	7.0	10 23 86	7.05	11 27 86	7.0
240	156	"	23.6	6 15	3	6.55	6.6	2 8 82	6.6	11 18 86	6.5	12 22 88	6.5
241	157	"	23.6	22 17	5	5.05	5.3	11 11 84	4.9	10 23 86	5.2	11 18 86	5.0
242	120	*Piscium*	23.6	+ 5 30	3	5.05	5.0	1 27 82	5.0	12 19 86	5.1	12 21 86	5.1
243	115	*Sculptoris*	23.8	−26 16	5	6.55	6.6	11 11 84	6.5	10 23 86	6.45	12 24 88	6.7
244	116	"	24.5	26 51	3	6.2	6.2	11 11 84	6.2	10 23 86	6.2	12 24 88	6.15
245	158	*Ceti*	24.7	5 36	4	6.85	7.0	2 8 82	6.95	11 18 86	6.8	11 17 87	6.85
246	159	"	25.5	12 54	3	7.0	6.9	1 3 83	7.0	10 23 86	7.05	11 27 86	6.9
247	160	"	25.7	7 22	4	7.4	6.9	11 14 84	7.2	11 28 86	7.4	11 17 87	7.5
248	117	*Sculptoris*	25.7	30 38	3	6.85	6.8	11 14 84	6.8	10 23 86	6.85	12 28 88	6.85
249	118	"	25.9	30 56	4	6.05	6.0	11 14 84	6.0	10 23 86	6.15	11 9 87	6.05
250	161	*Ceti*	26.2	24 17	3	7.0	7.0	11 11 84	7.0	10 23 86	6.95	12 22 88	7.0
251	162	"	25.5	19 40	3	6.35	6.3	11 11 84	6.3	10 23 86	6.35	12 22 88	6.35
252	163	"	26.8	9 40	3	6.5	6.5	11 14 84	6.5	10 23 86	6.55	12 2 88	6.45
253	121	*Piscium*	26.8	+ 7 34	3	6.85	6.7	2 8 82	6.8	12 21 86	6.85	12 24 88	6.85
254	164	*Ceti*	27.3	−24 49	3	6.95	7.0	11 11 84	7.0	10 23 86	6.95	12 22 88	6.95
255	165	"	27.4	7 40	4	5.9	5.9	2 8 82	5.8	11 14 84	5.9	11 18 86	5.95
256	166	"	1 28.5	4 10	3	6.55	6.5	2 8 82	6.6	11 18 86	6.5	12 24 88	6.5

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
257	167	*Ceti*	1 28.5	−16 19	5	5.5	5.6	1 3 83	5.4	10 23 86	5.45	11 26 86	5.5
258	168	"	28.9	24 20	3	6.65	6.7	11 11 84	6.7	10 23 86	6.7	12 22 88	6.5
259	122	*Piscium*	29.5	+ 7 0	4	6.9	7.0	2 8 82	7.0	12 21 86	6.85	11 17 87	6.8
260	169	*Ceti*	29.9	−16 2	4	5.6	5.5	1 3 83	5.5	10 23 86	5.6	11 26 86	5.7
261	123	*Piscium*	30.2	+ 7 12	2	6.7	6.7	2 8 82	6.7	12 21 86	6.7	.. .. ..	...
262	121	*Sculptoris*	30.4	−30 33	4	5.75	5.9	11 14 84	5.7	10 23 86	5.9	11 9 87	5.75
263	170	*Ceti*	31.4	10 3	4	6.2	6.2	11 14 84	6.2	10 23 86	6.2	11 26 86	6.1
264	171	"	31.5	4 5	6	6.65	6.6	2 8 82	6.4	11 18 86	6.8	11 28 86	6.75
265	172	"	32.9	21 55	5	5.65	5.7	11 11 84	5.5	10 23 86	5.85	11 18 86	5.7
266	123	*Sculptoris*	33.0	25 40	2	6.6	6.6	11 11 84	6.6	10 23 86	6.6	.. .. ..	...
267	124	"	33.5	29 40	5	7.1	6.9	11 14 84	7.1	10 23 86	7.0	11 21 86	7.0
268	124	*Piscium*	34.0	+ 8 8	3	6.4	6.5	2 8 82	6.45	12 21 86	6.45	12 24 88	6.35
269	173	*Ceti*	34.4	− 3 15	4	6.8	6.8	2 8 82	6.7	11 18 86	6.8	11 17 87	6.85
270	125	*Piscium*	34.9	+ 4 51	2	4.6	4.5	1 27 82	4.6	12 21 86	4.6	.. .. ..	...
271	174	*Ceti*	35.6	−11 57	3	5.85	5.8	1 3 83	5.9	10 23 86	5.8	11 26 86	5.8
272	175	"	36.4	4 19	4	5.25	5.2	2 8 82	5.2	11 18 86	5.3	12 24 88	5.35
273	176	"	37.6	5 24	3	6.45	6.5	2 8 82	6.4	11 18 86	6.5	11 27 86	6.5
274	126	*Piscium*	38.1	+ 2 36	3	6.85	6.8	1 29 82	6.9	12 21 86	6.8	12 24 88	6.9
275	177	*Ceti*	38.3	−16 36	7	3.25	3.4	11 9 84	3.25	11 11 84	3.5	10 23 86	3.25
276	178	"	38.5	7 24	4	6.35	6.4	2 8 82	6.3	11 18 86	6.35	11 27 86	6.4
277	127	*Piscium*	38.8	+ 8 32	4	4.3	4.3	1 27 82	4.15	12 21 86	4.2	12 24 88	4.45
278	128	"	39.1	7 56	3	6.65	6.7	2 8 82	6.7	12 21 86	6.6	12 24 88	6.6
279	129	"	39.3	3 2	3	6.85	6.8	1 29 82	6.9	12 21 86	6.8	12 24 88	6.9
280	130	"	39.5	2 48	5	6.7	6.7	1 29 82	6.5	12 21 86	6.7	11 17 87	6.65
281	179	*Ceti*	39.7	− 6 22	3	5.55	5.5	2 8 82	5.5	11 18 86	5.6	12 24 88	5.6
282	131	*Sculptoris*	39.8	25 41	3	5.35	5.4	11 11 84	5.3	10 23 86	5.4	12 28 88	5.3
283	1	*Fornacis*	40.2	27 58	3	6.35	6.4	11 14 84	6.3	10 23 86	6.45	11 21 86	6.35
284	180	*Ceti*	40.9	14 31	3	6.55	6.6	11 17 84	6.6	10 23 86	6.5	12 22 88	6.55
285	181	"	41.7	21 28	2	6.9	6.8	11 11 84	6.9	12 20 86	6.9	.. .. ..	...
286	131	*Piscium*	42.0	+ 3 4	4	6.15	5.9	1 29 82	6.15	12 21 86	6.1	12 12 87	6.2
287	..	*Fornacis*	42.8	−26 53	3	6.9	..	11 14 84	6.9	10 23 86	7.05	11 21 86	6.8
288	182	*Ceti*	43.5	11 18	3	4.6	4.8	11 9 84	4.6	11 11 84	4.6	10 23 86	4.6
289	183	"	44.0	7 19	4	6.8	6.9	11 18 86	6.9	11 27 86	6.7	11 17 87	6.75
290	184	"	44.2	13 31	3	7.0	7.0	11 17 84	7.0	10 23 86	7.0	12 22 88	7.0
291	185	"	45.3	10 57	8	3.7	3.5	11 9 84	3.85	11 11 84	3.9	10 23 86	3.7
292	186	"	45.4	7 29	3	6.6	6.4	11 18 86	6.65	11 27 86	6.6	12 24 88	6.6
293	187	"	45.7	16 16	3	6.65	6.7	11 17 84	6.6	10 23 86	6.7	12 22 88	6.7
294	188	"	46.9	17 33	3	5.75	5.8	11 17 84	5.7	10 23 86	5.8	12 22 88	5.7
295	132	*Piscium*	47.1	+ 2 34	3	4.75	4.7	1 27 82	4.8	12 21 86	4.7	12 24 88	4.7
296	133	"	47.8	8 10	4	6.9	6.8	2 8 82	6.9	12 21 86	6.9	12 24 88	6.85
297	7	*Fornacis*	49.3	−25 30	2	7.0	6.9	12 7 84	7.0	11 18 86	7.0	.. .. ..	...
298	189	*Ceti*	49.4	+ 1 14	4	6.05	6.3	1 29 82	6.15	11 28 86	6.1	12 24 88	6.0
299	190	"	50.8	−23 8	4	5.1	5.0	11 9 84	5.1	11 11 84	5.1	11 18 86	5.1
300	191	"	51.1	10 51	4	6.6	6.4	12 16 84	6.7	11 19 86	6.7	12 24 88	6.55
301	192	"	51.6	2 40	5	6.35	6.4	1 29 82	6.4	2 14 82	6.3	1 26 84	6.4
302	193	"	52.6	11 54	3	6.55	6.6	12 16 84	6.5	11 19 86	6.6	12 24 88	6.55
303	194	"	53.2	23 32	3	6.85	7.0	12 7 84	7.0	11 18 86	6.8	11 17 87	6.8
304	134	*Piscium*	53.4	+ 5 26	4	6.8	6.9	2 8 82	6.75	12 21 86	6.8	12 24 88	6.9
305	195	*Ceti*	53.5	−14 29	4	6.9	6.9	11 17 84	7.0	10 23 86	6.85	11 17 87	7.0
306	10	*Fornacis*	53.6	27 2	3	6.65	6.6	11 14 84	6.7	11 18 86	6.6	11 21 86	6.65
307	135	*Piscium*	53.7	+ 2 30	5	6.0	6.0	1 29 82	5.9	11 28 86	6.15	12 21 86	5.8
308	196	*Ceti*	53.9	−21 26	3	5.9	5.7	12 7 84	5.9	11 18 86	5.95	12 24 88	5.85
309	...	"	1 53.9	3 58	4	6.75	..	2 14 82	6.9	11 21 86	6.7	11 26 86	6.75

No.	U. A. No.	Name.	1875.		No. Obs.	Mag.		Separate Observations.					
			R. A.	Decl.		Mean Obs'd.	U. A.	Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
310	197	*Ceti*	1 54.1	−21 41	3	4.2	3.9	11 9 84	4.3	11 11 84	4.2	10 23 86	4.15
311	198	"	54.2	9 8	4	5.6	5.7	12 16 84	5.6	11 19 86	5.5	12 24 88	5.55
312	...	"	54.6	9 5	4	7.3	7.4	12 16 84	7.2	11 19 86	7.3	12 24 88	7.3
313	11	*Fornacis*	54.9	25 2	2	7.0	7.0	12 7 84	7.0	11 18 86	7.0	.. .. ..	...
314	136	*Piscium*	55.3	+ 7 16	4	7.0	7.0	2 8 82	6.9	12 21 86	7.0	12 24 88	7.0
315	137	"	55.6	2 10	4	3.55	3.8	2 24 86	3.5	11 24 86	3.5	12 24 88	3.55
316	12	*Fornacis*	55.7	−30 36	4	5.6	5.5	11 14 84	5.7	10 23 86	5.5	11 9 87	5.7
317	199	*Ceti*	56.5	2 59	5	6.7	6.8	1 29 82	6.7	2 14 82	6.7	1 26 84	6.6
318	200	"	56.8	22 34	4	6.9	7.0	12 7 84	7.0	11 18 86	6.8	11 12 87	7.0
319	201	"	56.8	0 28	5	5.45	5.4	1 29 82	5.4	2 14 82	5.35	1 26 84	5.6
320	13	*Fornacis*	56.9	30 16	3	6.65	6.7	11 14 84	6.5	10 23 86	6.75	11 9 87	6.65
321	202	*Ceti*	57.0	15 55	4	6.05	5.9	11 17 84	6.0	10 23 86	6.0	12 24 88	6.2
322	14	*Fornacis*	57.1	24 29	4	6.55	6.2	12 7 84	6.6	11 18 86	6.5	11 9 87	6.6
323	203	*Ceti*	57.4	4 42	5	5.85	5.8	1 29 82	5.8	2 14 82	5.8	1 26 84	5.9
324	204	"	57.4	0 56	6	6.1	5.9	1 29 82	6.1	2 14 82	6.1	1 26 84	6.1
325	205	"	58.1	12 28	3	6.7	6.7	12 16 84	6.7	11 19 86	6.6	12 24 88	6.8
326	138	*Piscium*	58.2	+ 7 8	4	6.55	6.5	2 8 82	6.6	12 21 86	6.6	12 24 88	6.5
327	15	*Fornacis*	58.9	−29 54	3	4.8	4.9	11 14 84	4.8	10 23 86	4.8	11 19 86	4.8
328	139	*Piscium*	59.2	+ 6 26	4	6.8	6.9	2 8 82	6.75	12 21 86	6.7	12 24 88	6.85
329	140	"	1 59.6	7 39	5	6.7	6.6	2 8 82	6.75	12 21 86	6.7	12 24 88	6.65
330	206	*Ceti*	2 0.0	−10 52	4	6.6	6.6	12 16 84	6.5	11 19 86	6.6	12 25 88	6.65
331	207	"	0.1	0 34	7	6.55	6.3	1 29 82	6.7	2 14 82	6.5	1 26 84	6.6
332	208	"	0.9	9 12	3	6.8	6.7	12 16 84	6.8	11 19 86	6.8	12 25 88	6.8
333	209	"	1.0	19 44	3	6.65	6.7	12 16 84	6.7	11 18 86	6.6	11 27 86	6.7
334	210	"	1.2	1 12	6	6.8	7.0	1 29 82	6.7	2 14 82	6.7	1 26 84	6.9
335	211	"	2.2	10 38	3	6.85	6.9	12 16 84	6.8	11 19 86	6.9	12 25 88	6.8
336	212	"	2.3	7 16	3	6.65	6.6	12 16 84	6.7	12 27 89	6.7	1 14 90	6.6
337	16	*Fornacis*	2.5	28 10	4	7.0	7.0	11 14 84	7.1	11 21 86	6.95	12 12 87	7.05
338	213	*Ceti*	2.8	18 22	4	6.55	6.5	12 16 84	6.5	11 18 86	6.6	11 24 86	6.65
339	214	"	3.4	+ 3 11	3	6.9	6.8	2 14 82	6.85	11 24 86	6.9	12 25 88	6.9
340	18	*Fornacis*	3.9	−24 56	4	6.45	6.4	12 7 84	6.4	11 18 86	6.4	11 19 86	6.6
341	215	*Ceti*	4.8	+ 7 59	5	5.7	5.7	2 14 82	5.95	11 28 86	5.7	12 25 86	5.7
342	216	"	5.1	−15 40	2	6.6	6.6	11 17 84	6.6	10 23 86	6.6	.. .. ..	...
343	...	"	5.1	28 49	3	7.0	..	11 14 84	7.1	11 21 86	6.95	12 12 87	6.95
344	217	"	5.2	+ 2 52	4	6.75	6.7	2 14 82	6.85	11 24 86	6.8	12 25 88	6.7
345	218	"	5.3	− 2 25	4	6.05	6.0	1 29 82	6.1	2 14 82	6.1	11 21 86	6.0
346	219	"	5.3	10 38	3	5.95	5.9	12 16 84	6.0	11 19 86	5.95	12 25 88	5.95
347	220	"	5.7	19 54	3	6.75	6.7	12 16 84	6.7	11 18 86	6.8	11 27 86	6.8
348	222	"	5.6	18 20	3	6.75	6.8	12 16 84	6.7	11 18 86	6.8	11 27 86	6.75
349	221	"	5.8	+ 2 9	3	6.8	6.8	2 14 82	6.85	11 24 86	6.7	12 25 86	6.8
350	...	"	6.1	−18 19	4	7.2	7.3	12 16 84	7.0	11 18 86	7.2	11 27 86	7.2
351	223	"	6.4	+ 8 16	5	4.6	4.3	1 27 82	4.4	11 28 86	4.55	12 25 86	4.65
352	224	"	6.4	− 2 59	6	5.55	5.8	1 29 82	5.55	2 14 82	5.6	1 26 84	5.4
353	225	"	7.0	+ 4 26	4	6.8	6.8	2 14 82	6.85	11 24 86	6.8	12 25 88	6.7
354	226	"	7.2	−21 35	2	5.7	5.8	12 16 84	5.7	11 18 86	5.7	.. .. ..	...
355	19	*Fornacis*	7.4	31 19	3	5.3	5.4	11 14 84	5.4	10 23 86	5.2	12 12 87	5.35
356	227	*Ceti*	7.7	9 39	5	6.7	6.5	12 16 84	6.6	11 19 86	6.8	11 28 86	6.8
357	228	"	8.8	+ 0 8	4	6.7	6.8	2 14 82	6.85	12 20 86	6.7	12 25 86	6.6
358	229	"	9.3	−10 3	4	6.4	6.4	12 16 84	6.5	11 19 86	6.3	12 25 86	6.45
359	230	"	10.1	10 24	3	6.7	6.8	12 16 84	6.7	11 19 86	6.8	12 25 88	6.65
360	231	"	10.8	7 0	3	5.5	5.7	11 21 86	5.4	12 20 86	5.6	12 25 86	5.5
361	232	"	11.5	+ 1 10	3	6.2	6.1	2 14 82	6.1	11 24 86	6.25	11 26 86	6.2
362	234	"	2 13.4	− 4 55	4	6.5	6.8	2 14 82	6.5	1 26 84	6.5	11 21 86	6.5

No.	U. A. No.	Name	1875.		No. Obs.	Mag.		Separate Observations.					
			R. A.	Decl.		Mean Obs'd	U. A	Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° '									
363	22	*Fornacis*	2 13.4	−26 32	4	6.45	6.5	12 7 84	6.4	11 19 86	6.6	12 12 87	6.45
364	235	*Ceti*	15.4	20 29	3	6.7	6.7	12 16 84	6.6	11 18 86	6.8	12 25 86	6.7
365	236	"	15.5	0 11	5	6.0	5.8	2 14 82	5.8	1 26 84	6.0	11 24 86	6.05
366	237	"	15.9	1 27	7	5.7	5.9	2 14 82	5.95	1 26 84	5.8	11 24 86	5.65
367	238	"	15.9	11 21	2	5.2	5.4	12 16 84	5.2	11 21 86	5.2	.. .. ..	...
368	239	"	16.2	18 14	3	6.05	5.9	12 16 84	6.0	11 18 86	6.1	12 12 87	6.0
369	23	*Fornacis*	16.8	24 23	3	5.25	5.4	11 18 86	5.25	11 19 86	5.15	12 12 87	5.35
370	240	*Ceti*	17.1	18 55	2	6.25	6.3	12 16 84	6.25	11 18 86	6.25	.. .. ..	...
371	241	"	17.2	6 46	3	6.95	6.9	11 21 86	7.0	12 20 86	6.9	12 25 88	6.9
372	24	*Fornacis*	17.8	27 34	3	6.7	6.8	12 7 84	6.6	11 19 86	6.8	12 12 87	6.7
373	242	*Ceti*	18.1	3 40	6	7.1	7.0	2 14 82	7.1	1 26 84	7.1	11 21 86	7.15
374	243	"	18.2	16 49	3	6.65	6.4	12 16 85	6.7	11 21 86	6.7	11 26 86	6.6
375	244	"	18.7	4 28	4	6.85	7.0	2 14 82	6.8	1 26 84	7.0	11 21 86	6.8
376	245	"	18.7	3 21	6	6.55	6.5	2 14 82	6.35	1 26 84	6.5	11 21 86	6.65
377	26	*Fornacis*	18.7	26 25	3	6.6	6.6	12 7 84	6.6	11 19 86	6.6	12 12 87	6.6
378	246	*Ceti*	19.7	+ 5 44	4	6.8	6.9	2 15 82	6.7	12 20 86	6.9	12 25 86	6.8
379	247	"	19.9	−12 51	3	4.65	4.6	12 16 84	4.7	2 23 86	4.6	11 18 86	4.65
380	248	"	20.1	15 54	3	5.6	5.7	12 16 84	5.6	11 21 86	5.55	12 25 88	5.6
381	249	"	20.8	+ 9 39	5	6.6	6.7	2 15 82	6.5	11 26 86	6.45	12 13 87	6.65
382	250	"	20.8	−20 37	2	5.9	6.0	12 16 84	5.9	11 19 86	5.9	.. .. ..	...
383	251	"	21.5	+ 7 54	7	4.3	4.4	2 15 82	4.4	2 24 86	4.35	11 21 86	4.15
384	252	"	21.6	1 24	9	6.8	6.9	2 15 82	6.5	1 24 86	6.9	11 28 86	6.75
385	253	"	22.7	−11 54	5	7.0	6.9	12 16 84	7.1	11 19 86	7.0	12 25 86	6.95
386	254	"	22.9	+ 9 0	7	6.35	6.4	2 15 82	6.8	11 26 86	6.2	11 28 86	6.2
387	255	"	23.5	−21 36	2	7.0	6.9	12 16 84	7.0	11 19 86	7.0	.. .. ..	...
388	257	"	24.2	23 14	3	6.75	6.7	12 16 84	6.8	11 19 86	6.7	12 25 88	6.7
389	256	"	24.4	0 18	8	6.35	6.5	2 15 82	6.5	1 26 84	6.4	11 24 86	6.25
390	30	*Fornacis*	24.6	25 45	3	6.4	6.5	12 7 84	6.4	11 19 86	6.3	12 12 87	6.45
391	258	*Ceti*	24.9	23 6	3	6.4	6.3	12 16 84	6.45	11 19 86	6.35	12 25 88	6.35
392	259	"	25.0	+ 1 43	10	5.9	5.7	2 15 82	5.3	11 24 86	5.95	11 26 86	5.9
393	...	"	25.2	0 33	4	6.9	..	2 15 82	6.8	11 24 86	7.0	12 25 86	6.8
394	260	"	25.8	− 1 35	5	5.7	5.9	2 15 82	5.5	1 26 84	5.8	11 24 86	5.75
395	261	"	26.2	15 48	3	4.65	4.8	12 16 84	4.6	2 23 86	4.7	11 18 86	4.65
396	...	"	27.7	13 53	..	var.	..	.. .. ..	...	.. .. ..	...	.. .. ..	...
397	262	"	27.9	12 53	3	6.75	6.7	12 16 84	6.8	11 19 86	6.7	12 25 86	6.75
398	263	"	27.9	20 33	2	6.2	6.1	12 16 84	6.2	11 19 86	6.2	.. .. ..	...
399	34	*Fornacis*	28.4	28 47	5	5.05	4.9	11 14 84	5.0	11 18 86	5.1	11 19 86	5.3
400	264	*Ceti*	28.5	+ 6 56	5	6.35	5.9	2 15 82	6.5	11 26 86	6.35	12 20 86	6.3
401	265	"	28.5	− 8 24	7	5.8	5.5	12 16 84	5.6	11 21 86	6.1	11 24 86	5.7
402	266	"	28.9	22 29	3	7.0	7.0	12 16 84	7.0	11 19 86	7.0	12 25 88	7.0
403	267	"	29.1	4 6	5	6.95	7.0	2 15 82	6.8	1 26 84	7.0	11 21 86	7.0
404	268	"	29.2	+ 6 17	3	6.05	6.0	2 15 82	6.1	11 26 86	6.0	1 29 89	6.0
405	269	"	29.3	− 9 54	3	6.85	6.7	12 16 84	6.8	11 21 86	6.95	12 12 87	6.75
406	270	"	29.3	+ 5 3	6	5.15	5.1	2 15 82	4.9	11 21 86	5.3	11 24 86	5.3
407	...	"	29.7	−15 29	4	7.0	..	1 10 85	6.8	11 19 86	7.0	12 25 86	7.0
408	271	"	29.8	8 23	6	5.6	5.4	12 16 84	5.6	11 21 86	5.8	11 24 86	5.5
409	272	"	30.0	+ 7 11	7	6.1	5.6	2 15 82	6.3	11 26 86	6.05	11 28 86	6.1
410	...	"	30.1	−18 11	2	6.9	..	12 27 86	6.9	1 16 88	6.9	.. .. ..	...
411	273	"	30.3	21 57	3	6.75	6.7	12 16 84	6.8	11 19 86	6.7	12 25 88	6.75
412	274	"	30.6	15 12	4	6.9	7.0	1 10 85	6.8	11 19 86	6.9	12 25 86	6.95
413	275	"	31.1	20 40	3	6.95	7.0	12 16 84	7.0	11 19 86	6.9	12 25 88	7.0
414	276	"	31.4	+ 7 9	4	6.4	6.5	2 15 82	6.5	11 26 86	6.35	12 25 86	6.4
415	277	"	2 31.4	− 3 56	7	6.05	6.0	2 15 82	5.7	1 26 84	6.1	11 21 86	6.25

No.	U. A. No	Name.	1875.		No. Obs.	Mag.		Separate Observations.					
			R. A.	Decl.		Mean Obs'd.	U. A.	Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
416	278	*Ceti*	2 32.1	−23 32	3	6.75	6.8	12 16 84	6.8	11 19 86	6.7	12 25 88	6.7
417	279	"	32.1	+ 2 54	2	6.5	6.5	2 15 82	6.5	11 26 86	6.5	.. .. ..	...
418	280	"	32.8	−21 0	4	6.9	6.9	12 16 84	6.8	11 19 86	6.9	12 25 88	7.0
419	281	"	32.9	9 28	4	7.0	7.0	12 16 84	7.1	11 21 86	7.0	12 25 86	6.95
420	282	"	33.1	10 22	7	6.75	6.7	12 16 84	6.6	11 21 86	6.8	12 25 86	7.0
421	283	"	33.1	0 13	4	3.9	4.0	2 24 86	3.9	11 21 86	3.9	11 24 86	3.9
422	284	"	33.5	12 24	5	4.75	4.6	12 16 84	4.9	2 23 86	4.75	11 18 86	4.65
423	285	"	33.7	+ 5 34	5	6.35	6.4	2 15 82	6.5	11 26 86	6.2	11 28 86	6.35
424	286	"	34.1	− 9 59	9	5.55	5.7	12 16 84	5.7	11 21 86	5.7	11 24 86	5.4
425	287	"	34.5	14 59	3	6.65	6.7	1 10 85	6.7	11 19 86	6.6	12 25 86	6.65
426	288	"	34.8	1 14	5	6.15	6.2	2 15 82	5.9	1 26 84	6.2	11 24 86	6.25
427	289	"	35.5	3 45	5	6.5	6.5	2 15 82	6.5	1 26 84	6.5	11 21 86	6.45
428	290	"	35.6	15 2	4	6.05	6.2	1 10 85	6.1	11 19 86	6.0	12 24 88	5.9
429	291-2	"	36.8	+ 2 43	4	3.1	3.2	2 24 86	3.0	11 21 86	3.15	11 24 86	3.15
430	293	"	37.2	− 3 4	6	6.85	6.8	2 15 82	6.7	1 26 84	6.8	11 21 86	6.9
431	294	"	37.8	8 26	3	6.75	6.8	12 16 84	6.8	11 21 86	6.7	12 24 88	6.7
432	295	"	38.2	+ 9 35	5	4.5	4.3	2 24 86	4.7	11 21 86	4.4	11 24 86	4.4
433	296	"	38.2	−14 23	6	4.05	4.1	12 16 84	4.0	2 23 86	4.15	11 18 86	4.15
434	41	*Fornacis*	38.3	28 26	3	6.85	7.0	1 10 85	6.8	11 18 86	6.7	12 28 88	7.0
435	43	"	38.7	26 2	2	6.9	7.0	1 10 85	6.9	11 19 86	6.9	.. .. ..	...
436	297	*Ceti*	38.8	+ 4 11	6	6.2	6.3	2 15 82	6.5	11 24 86	6.1	11 28 86	6.2
437	22	*Eridani*	39.3	−19 6	3	4.4	4.5	2 6 82	4.4	12 16 84	4.4	2 23 86	4.4
438	298	*Ceti*	39.4	22 42	4	7.0	7.0	1 10 85	6.9	11 19 86	7.1	12 25 86	7.05
439	23	*Eridani*	39.6	20 56	2	7.0	7.0	1 10 85	7.0	11 19 86	7.0	.. .. ..	...
440	...	"	40.8	22 11	3	7.35	7.5	1 10 85	7.4	11 19 86	7.3	12 28 88	7.3
441	26	"	41.1	22 10	3	6.7	6.7	1 10 85	6.75	11 19 86	6.7	12 28 88	6.7
442	27	"	41.6	23 1	2	6.6	6.5	1 10 85	6.6	11 19 86	6.6	.. .. ..	...
443	299	*Ceti*	43.2	+ 0 24	5	7.0	7.0	2 15 82	7.0	11 24 86	6.85	12 25 86	7.2
444	28	*Eridani*	44.1	− 5 30	7	7.15	6.9	1 10 85	7.2	11 26 86	7.1	12 25 86	7.1
445	50	*Fornacis*	44.3	25 4	4	6.4	6.4	1 10 85	6.6	11 19 86	6.35	12 12 87	6.45
446	51	"	44.5	28 28	2	5.5	5.6	1 10 85	5.5	11 18 86	5.5	.. .. ..	...
447	30	*Eridani*	45.4	21 31	3	4.95	4.9	2 6 82	5.0	2 23 86	4.9	12 28 88	4.95
448	32	"	46.5	13 17	2	6.2	6.1	1 10 85	6.2	11 19 86	6.2	.. .. ..	...
449	33	"	46.8	9 57	5	6.4	6.4	12 16 84	6.2	11 21 86	6.45	11 24 86	6.4
450	300	*Ceti*	47.1	+ 8 49	3	6.95	6.9	2 15 82	7.0	11 28 86	6.9	12 25 88	7.05
451	301	"	47.2	1 28	5	6.95	6.9	2 15 82	7.0	11 24 86	6.85	12 25 86	7.1
452	34	*Eridani*	47.7	−22 36	2	6.9	6.8	1 10 85	6.9	11 19 86	6.9	.. .. ..	...
453	35	"	48.0	22 53	3	6.25	6.3	1 10 85	6.3	11 19 86	6.25	12 28 88	6.25
454	37	"	48.1	10 57	5	6.8	6.8	12 16 84	6.6	11 21 86	6.8	11 26 86	6.9
455	302	*Ceti*	48.4	0 34	5	6.8	6.7	2 15 82	7.0	11 24 86	6.85	12 25 86	6.7
456	303	"	48.6	+ 2 59	4	6.9	7.0	10 20 86	6.9	11 24 86	6.9	1 16 88	6.9
457	38	*Eridani*	49.0	−14 32	2	6.8	6.8	1 10 85	6.8	11 21 86	6.8	.. .. ..	...
458	304	*Ceti*	49.1	+ 1 31	5	6.7	6.8	2 15 82	6.7	11 24 86	6.65	12 20 86	6.9
459	305	"	49.6	7 53	3	6.35	6.3	2 15 82	6.3	11 28 86	6.4	12 25 88	6.35
460	58	*Fornacis*	50.0	−25 49	3	6.9	6.9	1 10 85	6.9	11 19 86	6.8	12 28 88	7.0
461	39	*Eridani*	50.3	9 24	9	3.9	3.7	2 6 82	3.8	3 7 82	4.0	12 16 84	3.8
462	40	"	50.4	4 13	4	5.0	5.1	2 15 82	4.9	2 23 86	5.0	11 21 86	5.1
463	306	*Ceti*	50.5	+ 4 0	4	6.75	6.7	2 15 82	6.7	11 24 86	6.9	1 16 88	6.75
464	307	"	50.8	− 0 3	4	6.7	6.7	2 15 82	6.7	11 24 86	6.65	1 16 88	6.65
465	41	*Eridani*	51.8	24 22	5	5.7	5.7	2 6 82	5.8	1 10 85	5.6	11 18 86	5.5
466	...	*Fornacis*	51.8	25 28	3	7.1	7.0	1 10 85	7.1	11 19 86	7.2	12 28 88	7.0
467	61	"	51.9	30 22	4	6.4	6.3	1 10 85	6.35	11 18 86	6.4	1 16 87	6.4
468	42	*Eridani*	2 52.2	12 30	3	6.8	6.6	1 10 85	6.8	11 21 86	6.7	12 28 88	6.85

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U.A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
469	43	*Eridani*	2 52.4	− 3 17	3	5.25	5.2	2 15 82	5.2	2 23 86	5.2	11 21 86	5.3
470	44	"	52.5	24 7	3	6.25	6.2	1 10 85	6.2	11 19 86	6.2	12 28 88	6.3
471	45	"	52.7	10 17	4	6.25	6.2	12 16 84	6.1	11 21 86	6.3	12 21 86	6.3
472	308	*Ceti*	53.0	+ 8 25	4	4.75	4.8	2 15 82	4.6	11 21 86	4.8	11 24 86	4.8
473	46	*Eridani*	53.4	− 2 58	6	5.6	5.4	2 15 82	5.9	2 23 86	5.45	11 21 86	5.5
474	47	"	53.5	7 41	4	7.05	7.0	3 7 82	7.0	11 24 86	7.1	11 26 86	7.1
475	63	*Fornacis*	53.8	29 24	4	6.3	6.3	1 10 85	6.2	11 18 86	6.4	1 16 87	6.3
476	50	*Eridani*	54.0	14 11	3	6.9	6.9	1 10 85	6.9	11 21 86	6.8	12 28 88	6.95
477	65	*Fornacis*	54.1	25 47	3	5.85	5.9	1 10 85	5.85	11 18 86	5.9	11 19 86	5.8
478	51	*Eridani*	54.6	3 23	7	6.8	6.9	1 10 85	6.45	1 18 85	6.8	11 26 86	6.8
479	52	"	55.0	8 9	6	6.1	6.1	3 7 82	6.2	2 23 86	5.95	11 24 86	6.2
480	309	*Ceti*	55.3	+ 4 51	3	6.75	6.6	2 15 82	6.7	11 24 86	6.8	12 25 88	6.7
481	310	"	55.8	3 36	4	2.6	2.4	2 24 86	2.6	11 21 86	2.6	11 24 86	2.65
482	311	"	55.8	3 52	4	6.3	6.4	2 15 82	6.5	11 24 86	6.4	12 25 88	6.3
483	53	*Eridani*	55.9	−10 27	5	6.05	6.3	1 10 85	5.85	11 21 86	6.1	12 25 86	6.15
484	54	"	56.0	6 59	3	6.75	6.7	3 7 82	6.7	11 24 86	6.7	11 26 86	6.8
485	68	*Fornacis*	56.2	28 34	6	6.1	6.0	1 10 85	6.2	11 18 86	6.1	11 19 86	6.2
486	55	*Eridani*	56.6	8 11	5	5.7	5.6	3 7 82	5.8	2 23 86	5.7	11 24 86	5.6
487	56	"	56.9	24 7	5	3.95	4.1	2 6 82	4.1	11 18 86	3.9	11 19 86	3.8
488	312	*Ceti*	56.9	+ 5 44	3	6.9	6.9	2 15 82	6.9	11 24 86	7.0	12 25 88	6.8
489	. . .	"	57.2	5 38	4	7.1	7.3	2 15 82	7.0	11 24 86	7.2	11 16 88	7.1
490	57	*Eridani*	58.1	− 8 6	8	5.35	5.3	3 7 82	5.6	2 23 86	5.45	11 24 86	5.1
491	313	*Ceti*	58.2	+ 1 23	2	6.6	6.6	2 15 82	6.6	12 20 86	6.6	. . . . . .	. . .
492	59	*Eridani*	2 59.1	− 8 46	4	6.75	6.9	3 7 82	6.7	11 24 86	6.7	11 26 86	6.8
493	61	"	3 0.4	6 34	3	5.85	5.8	3 7 82	5.8	11 24 86	5.9	11 26 86	5.8
494	62	"	0.5	10 44	4	6.85	6.7	1 10 85	6.9	11 21 86	6.7	1 16 87	6.85
495	63	"	1.4	14 14	2	6.8	6.9	1 10 85	6.8	11 21 86	6.8	. . . . . .	. . .
496	314	*Ceti*	2.0	+ 7 59	4	6.7	6.6	2 15 82	6.75	11 28 86	6.8	12 28 88	6.55
497	69	*Fornacis*	2.5	−28 19	6	6.15	6.2	1 10 85	6.35	11 18 86	6.1	11 19 86	6.2
498	64	*Eridani*	5.1	4 17	2	6.75	6.7	2 15 82	6.75	11 26 86	6.75	. . . . . .	. . .
499	65	"	5.1	24 13	2	6.6	6.6	1 10 85	6.6	11 19 86	6.6	. . . . . .	. . .
500	66	"	5.2	13 44	3	6.5	6.4	1 10 85	6.45	11 21 86	6.6	12 21 86	6.5
501	67	"	5.5	16 30	4	6.5	6.5	1 10 85	6.4	11 19 86	6.6	12 21 86	6.4
502	315	*Ceti*	5.8	+ 6 11	3	6.1	6.1	2 15 82	6.1	11 28 86	6.0	12 28 88	6.15
503	316	"	6.4	− 1 40	3	5.3	5.3	2 15 82	5.35	11 21 86	5.25	11 24 86	5.3
504	68	*Eridani*	6.6	21 6	3	6.9	6.9	1 10 85	6.9	11 19 86	6.9	12 25 88	6.85
505	72	*Fornacis*	6.8	29 29	3	3.75	3.6	11 19 86	3.7	1 16 87	3.8	12 28 88	3.8
506	70	*Eridani*	7.3	20 30	3	6.95	7.0	1 10 85	6.9	11 19 86	7.0	12 25 88	6.95
507	74	*Fornacis*	8.1	28 3	4	6.75	6.4	1 10 85	6.7	11 18 86	6.7	1 16 87	6.8
508	76	"	8.4	30 16	4	6.45	6.4	1 10 85	6.4	11 18 86	6.55	1 16 87	6.4
509	78	"	9.6	26 34	4	6.35	6.3	1 10 85	6.45	11 19 86	6.2	1 16 87	6.45
510	72	*Eridani*	9.6	20 29	3	6.9	6.8	1 10 85	6.9	11 19 86	6.9	12 25 88	6.95
511	73	"	9.8	9 17	8	4.65	4.9	3 7 82	5.1	2 22 86	4.5	2 23 86	4.6
512	74	"	9.8	6 23	6	6.35	6.6	1 10 85	6.4	1 18 85	6.4	11 26 86	6.55
513	75	"	10.2	6 12	3	6.85	6.9	1 10 85	6.9	11 26 86	6.85	12 28 88	6.85
514	76	"	10.2	4 45	7	7.15	7.0	2 15 82	6.95	11 26 86	7.05	1 18 87	7.3
515	77	"	10.5	9 37	3	6.35	6.5	1 10 85	6.3	11 26 86	6.3	12 28 88	6.4
516	317	*Ceti*	10.5	+ 6 20	3	6.9	7.0	2 15 82	6.85	11 28 86	6.8	2 3 88	6.95
517	. . .	"	10.7	7 14	3	6.9	6.9	2 15 82	6.95	11 28 86	6.8	2 3 88	6.95
518	78	*Eridani*	11.8	−23 59	3	6.9	6.8	1 10 85	6.9	11 19 86	6.85	12 28 88	7.0
519	318	*Ceti*	12.0	1 23	5	5.65	5.7	2 15 82	5.6	11 21 86	5.6	11 24 86	5.9
520	319	"	12.8	+ 2 55	5	5.0	5.1	2 15 82	4.8	11 24 86	5.0	2 3 88	5.0
521	82	*Fornacis*	3 12.8	−29 15	5	6.1	5.9	1 10 85	6.1	11 18 86	6.2	1 16 87	6.05

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A	Separate Observations. Date.	Mag	Date	Mag.	Date	Mag.
			h. m.	° ′									
522	79	*Eridani*	3 12.9	−22 58	5	5.15	5.3	2 6 82	5.0	1 10 85	5.3	2 23 86	5.15
523	80	"	13.0	19 1	3	5.8	5.8	1 10 85	5.9	11 19 86	5.7	1 16 87	5.8
524	320	*Ceti*	13.3	+ 0 45	6	7.0	7.0	2 15 82	6.95	11 27 86	7.1	12 25 86	6.85
525	81	*Eridani*	14.0	−22 13	10	3.8	3.4	2 6 82	3.6	2 22 86	3.9	2 24 86	3.7
526	83	*Fornacis*	14.1	24 35	3	6.05	5.9	1 10 85	6.0	11 19 86	6.1	12 28 88	6.05
527	321	*Ceti*	14.6	+ 3 14	5	6.2	6.2	2 15 82	6.1	11 24 86	6.4	11 28 86	6.1
528	85	*Fornacis*	15.4	−26 45	4	6.9	7.0	1 10 85	6.9	11 19 86	7.0	1 16 87	6.8
529	86	"	15.4	27 4	5	6.55	6.5	1 10 85	6.45	11 19 86	6.5	1 16 87	6.6
530	83	*Eridani*	15.9	24 5	2	5.7	5.7	1 10 85	5.7	11 19 86	5.7	.. .. ..	...
531	84	"	16.1	20 47	4	6.7	6.6	1 10 85	6.75	11 19 86	6.7	12 25 88	6.6
532	85	"	16.7	21 33	3	6.95	6.9	1 10 85	6.9	11 19 86	6.9	12 25 88	7.0
533	87	*Fornacis*	16.9	26 2	4	6.4	6.5	1 10 85	6.4	11 19 86	6.3	1 16 87	6.4
534	1	*Tauri*	17.1	+ 4 26	3	6.65	6.6	2 15 82	6.6	11 28 86	6.75	2 24 87	6.65
535	2	"	17.2	0 28	2	6.95	6.9	2 15 82	6.95	11 27 86	6.95	.. .. ..	...
536	86	*Eridani*	17.2	− 8 14	7	6.55	6.5	1 10 85	6.45	1 18 85	6.8	11 26 86	6.7
537	87	"	17.6	17 53	4	6.85	6.8	1 10 85	7.0	11 19 86	6.7	12 21 86	6.9
538	88	"	18.6	14 26	4	6.85	6.9	3 7 82	6.9	12 25 86	6.85	12 25 88	6.8
539	90	*Fornacis*	21.1	27 46	4	6.1	6.1	1 10 85	6.2	11 19 86	6.0	1 16 87	6.2
540	90	*Eridani*	21.9	14 48	3	6.95	6.9	3 7 82	6.95	12 25 86	6.9	12 25 88	7.0
541	91	"	22.1	11 43	4	6.1	5.9	3 7 82	6.1	2 22 86	6.1	1 18 87	6.1
542	5	*Tauri*	22.6	+ 2 49	3	6.7	6.8	1 28 86	6.75	2 13 87	6.6	2 24 87	6.75
543	93	*Eridani*	23.5	− 7 14	9	6.35	6.1	1 10 85	6.45	1 18 85	6.4	11 26 86	6.3
544	94	"	23.7	13 6	4	5.7	5.8	3 7 82	5.8	2 22 86	5.7	12 25 88	5.6
545	95	"	24.1	23 55	3	6.85	6.9	1 10 85	6.9	11 19 86	6.85	12 25 88	6.85
546	6	*Tauri*	24.1	+ 5 46	3	6.4	6.3	2 15 82	6.45	11 28 86	6.45	2 13 87	6.35
547	96	*Eridani*	24.3	−12 4	3	6.85	6.8	3 7 82	6.9	2 22 86	6.8	12 25 88	6.8
548	98	"	24.3	22 56	5	7.0	7.0	1 10 85	6.9	11 19 86	7.05	1 18 87	7.1
549	97	"	24.4	5 30	4	4.8	4.7	2 15 82	4.9	2 22 86	4.7	2 23 86	4.7
550	7	*Tauri*	24.7	0 55	5	6.6	7.0	2 15 82	6.5	11 27 86	6.6	2 13 87	6.65
551	8	"	25.8	+ 8 57	4	6.0	6.0	2 15 82	6.1	2 13 87	5.9	2 24 87	5.9
552	94	*Fornacis*	26.6	−26 2	4	6.25	6.3	1 10 85	6.2	11 19 86	6.25	1 18 87	6.4
553	95	"	27.1	25 3	3	6.9	6.9	1 10 85	6.95	11 19 86	6.8	2 3 88	6.95
554	101	*Eridani*	27.1	9 53	5	3.55	3.6	2 6 82	3.5	3 7 82	3.55	2 22 86	3.5
555	102	"	27.4	15 58	5	7.0	7.0	1 10 85	7.0	12 25 86	7.05	1 18 87	7.05
556	...	"	27.6	7 50	6	7.0	..	11 26 86	6.8	12 21 86	7.05	1 18 87	7.0
557	9	*Tauri*	28.2	+ 6 0	3	6.8	6.8	2 15 82	6.8	11 28 86	6.75	2 13 87	6.8
558	103	*Eridani*	28.3	−22 3	9	3.95	4.5	2 6 82	4.1	2 22 86	3.7	2 24 86	3.95
559	104	"	28.6	10 17	4	6.4	6.3	3 7 82	6.4	2 22 86	6.4	12 25 86	6.4
560	97	*Fornacis*	29.5	26 0	4	6.5	6.5	1 10 85	6.4	11 19 86	6.5	2 3 88	6.5
561	105	*Eridani*	29.8	5 33	5	6.85	6.7	2 15 82	7.0	11 26 86	6.7	12 25 86	6.9
562	106	"	30.0	11 37	4	5.9	5.8	3 7 82	5.95	2 22 86	5.8	1 18 87	6.05
563	10	*Tauri*	30.4	+ 0 11	5	6.5	6.5	2 15 82	6.3	11 27 86	6.6	2 13 87	6.5
564	11	"	30.5	0 1	4	4.4	4.5	2 15 82	4.4	2 22 86	4.4	2 24 86	4.4
565	107	*Eridani*	30.6	−17 53	4	5.2	5.3	1 10 85	5.15	2 22 86	5.2	2 23 86	5.25
566	108	"	32.0	15 54	3	7.0	7.0	1 10 85	7.0	12 25 86	7.05	12 25 88	7.0
567	...	*Tauri*	32.2	+ 2 19	4	7.4	7.4	2 15 82	7.15	2 13 87	7.35	2 6 88	7.55
568	109	*Eridani*	32.4	− 7 48	7	6.1	6.1	1 10 85	6.45	1 18 85	5.8	11 26 86	6.1
569	12	*Tauri*	32.4	+ 2 21	3	7.15	7.0	2 15 82	7.15	2 13 87	7.15	12 28 88	7.2
570	111	*Eridani*	32.8	− 6 2	4	6.4	6.4	2 15 82	6.5	11 26 86	6.45	12 25 88	6.35
571	112	"	33.4	3 48	6	6.65	6.6	2 15 82	6.9	11 27 86	6.65	12 25 86	6.55
572	13	*Tauri*	33.4	+ 2 39	3	6.0	6.1	2 15 82	6.0	2 13 87	6.1	1 29 89	5.9
573	113	*Eridani*	33.5	−10 51	3	6.55	6.5	3 7 82	6.6	2 22 86	6.5	12 25 88	6.5
574	101	*Fornacis*	3 33.6	28 21	3	5.85	5.8	1 10 85	5.8	11 19 86	5.9	12 28 88	5.8

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
575	14	*Tauri*	3 33.6	− 1 32	3	6.5	6.6	2 15 82	6.5	11 27 86	6.6	12 25 88	6.45
576	...	*Eridani*	33.7	7 11	6	6.9	..	11 26 86	6.7	12 21 86	6.85	1 18 87	6.85
577	15	*Tauri*	33.9	+ 4 43	4	6.95	7.0	2 15 82	6.8	2 13 87	7.05	2 24 87	7.0
578	...	*Eridani*	33.9	−17 46	5	7.0	..	1 10 85	7.0	12 25 86	7.0	2 3 88	6.95
579	114	"	34.4	15 38	4	6.55	6.5	1 10 85	6.6	12 25 86	6.55	12 27 86	6.55
580	...	"	34.0	3 37	4	7.0	..	2 15 82	7.1	11 27 86	7.05	12 25 86	6.9
581	115	"	34.5	5 37	6	5.75	5.8	2 15 82	6.0	11 26 86	5.6	12 25 86	5.8
582	116	"	34.6	20 0	3	7.0	7.0	1 10 85	7.0	11 26 86	7.05	12 25 88	7.0
583	...	"	35.1	19 53	3	7.15	7.2	1 10 85	7.2	11 26 86	7.1	12 25 88	7.1
584	117	"	35.3	12 12	4	6.6	6.7	3 7 82	6.7	2 22 86	6.6	12 25 88	6.45
585	119	"	35.8	19 59	4	6.7	6.8	1 10 85	6.8	11 26 86	6.6	1 27 87	6.75
586	...	"	35.8	14 42	3	7.25	7.4	1 10 85	7.2	1 27 87	7.4	12 25 88	7.2
587	120	"	36.1	14 46	4	6.8	6.8	1 10 85	6.9	12 25 86	6.7	1 27 87	6.9
588	102	*Fornacis*	36.6	25 3	5	6.8	6.7	1 10 85	6.6	11 19 86	6.75	2 3 88	6.75
589	121	*Eridani*	37.3	10 11	5	3.3	3.3	2 6 82	3.3	3 7 82	3.3	2 22 86	3.3
590	122	"	37.6	10 53	4	5.9	5.9	3 7 82	5.95	2 22 86	5.9	12 25 88	5.85
591	123	"	38.2	1 34	5	5.45	5.4	2 15 82	5.5	2 22 86	5.4	2 24 86	5.5
592	125	"	38.5	0 41	5	6.05	5.9	2 15 82	6.0	2 22 86	6.0	11 27 86	6.1
593	16	*Tauri*	38.6	+ 2 14	5	6.8	6.7	2 15 82	6.5	2 13 87	6.9	2 24 87	6.9
594	17	"	39.0	5 39	3	5.6	5.7	2 15 82	5.5	2 13 87	5.65	2 24 87	5.6
595	18	"	39.5	6 25	3	6.5	6.4	2 15 82	6.45	2 13 87	6.5	1 29 89	6.5
596	127	*Eridani*	40.2	−12 30	7	4.9	4.7	3 7 82	4.5	2 22 86	5.1	2 23 86	5.0
597	104	*Fornacis*	40.3	26 18	3	6.9	6.7	1 10 85	6.9	11 19 86	6.95	12 28 88	6.8
598	105	"	41.4	29 44	3	5.8	5.7	1 10 85	5.8	11 19 86	5.9	12 28 88	5.75
599	128	*Eridani*	41.5	23 37	8	4.1	3.9	2 6 82	4.1	3 14 82	3.6	2 22 86	4.2
600	129	"	42.2	0 10	5	6.3	6.4	2 15 82	6.3	2 22 86	6.3	11 27 86	6.35
601	130	"	42.3	24 16	6	5.4	5.5	2 6 82	5.45	3 14 82	5.1	2 22 86	5.6
602	106	*Fornacis*	42.3	30 17	2	6.9	6.9	1 10 85	6.9	11 19 86	6.9	... ...	...
603	107	"	42.3	29 51	4	7.15	7.0	1 10 85	7.2	11 19 86	7.15	1 16 87	7.2
604	108	"	42.7	26 43	3	6.85	6.8	1 10 85	6.9	11 19 86	6.8	12 28 88	6.8
605	109	"	42.9	30 33	3	5.45	5.6	1 10 85	5.5	11 19 86	5.4	2 3 88	5.45
606	131	*Eridani*	43.0	1 50	6	6.75	7.0	2 17 82	6.4	11 27 86	6.85	12 25 86	6.8
607	132	"	43.1	21 17	4	6.35	6.3	3 14 82	6.45	11 26 86	6.4	12 25 88	6.2
608	110	*Fornacis*	43.8	26 25	3	6.85	7.0	1 10 85	6.9	11 19 86	6.8	12 28 88	6.8
609	134	*Eridani*	43.9	1 54	7	6.6	6.9	2 17 82	6.4	11 27 86	6.7	12 25 86	6.55
610	139	"	45.8	1 32	6	6.75	6.2	2 17 82	6.7	2 22 86	6.6	11 27 86	6.8
611	140	"	45.9	1 2	6	6.8	7.0	2 17 82	7.0	2 22 86	6.6	11 27 86	6.85
612	142	"	46.0	21 39	3	6.7	6.7	3 14 82	6.7	11 26 86	6.7	12 25 88	6.7
613	143	"	46.3	5 26	3	6.95	7.0	2 17 82	6.9	11 27 86	7.05	2 3 88	6.9
614	144	"	46.5	5 44	4	5.7	5.7	2 17 82	5.65	11 27 86	5.6	12 25 86	5.8
615	145	"	47.0	7 0	5	6.6	6.7	2 17 82	6.4	11 27 86	6.65	12 27 86	6.55
616	146	"	47.4	22 39	3	6.95	6.9	3 14 82	6.9	11 26 86	7.0	12 25 88	7.0
617	147	"	47.6	18 48	2	6.4	6.3	1 10 85	6.4	11 26 86	6.4	... ...	...
618	148	"	48.0	3 20	4	4.8	4.7	2 17 82	4.7	2 22 86	4.8	2 24 86	4.8
619	149	"	48.4	24 59	8	4.5	4.4	2 6 82	4.5	3 14 82	4.5	2 22 86	4.6
620	150	"	48.6	23 30	4	6.75	6.8	3 14 82	6.65	11 26 86	6.8	1 27 87	6.85
621	152	"	49.4	12 28	5	6.2	6.1	3 7 82	6.0	11 26 86	6.3	12 27 86	6.2
622	154	"	50.6	11 13	5	6.55	6.7	3 7 82	6.45	11 26 86	6.5	1 27 87	6.65
623	155	"	50.6	10 7	4	6.25	6.3	3 7 82	6.1	11 26 86	6.3	12 27 86	6.2
624	...	"	50.6	13 56	3	7.0	..	2 6 88	7.0	1 3 90	7.0	1 23 90	7.0
625	158	"	52.2	13 52	5	2.7	2.8	2 6 82	2.8	3 7 82	2.6	2 22 86	2.7
626	159	"	52.7	5 49	4	6.2	6.2	2 17 82	6.2	11 27 86	6.25	12 25 86	6.15
627	160	"	3 53.6	12 56	5	6.05	6.1	3 7 82	5.95	11 26 86	6.1	12 27 86	6.1

No.	U. A. No	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m	° ′									
628	161	*Eridani*	3 54.6	−24 22	8	4.4	4.4	2 6 82	4.5	3 14 82	4.1	2 22 86	4.4
629	162	"	55.2	1 54	4	5.2	5.3	2 17 82	5.3	2 22 86	5.2	2 24 86	5.2
630	164	"	56.2	0 37	4	5.7	5.6	2 17 82	5.8	2 22 86	5.7	2 24 86	5.7
631	166 167	"	57.9	20 29	5	6.1	6.0 6.9	3 13 82	6.2	11 26 86	6.15	1 27 87	6.1
632	168	"	58.5	16 56	3	6.8	6.7	1 10 85	6.8	11 26 86	6.75	12 25 88	6.85
633	169	"	58.5	13 8	3	5.9	6.0	3 7 82	5.95	11 26 86	5.95	12 25 88	5.85
634	171	"	59.2	20 43	3	6.3	6.1	3 13 82	6.3	11 26 86	6.25	12 25 88	6.3
635	172	"	3 59.9	9 12	4	6.35	6.3	3 7 82	6.2	12 27 86	6.4	1 18 87	6.35
636	173	"	4 0.3	20 51	3	6.45	6.4	3 13 82	6.5	11 26 86	6.4	12 25 88	6.5
637	174	"	0.5	28 0	4	5.85	5.8	2 6 82	6.0	11 26 86	5.8	1 18 87	5.7
638	176	"	1.0	18 23	4	6.85	7.0	1 10 85	6.8	11 26 86	6.75	2 6 88	6.9
639	177	"	1.1	10 20	5	6.95	7.0	3 7 82	7.1	12 27 86	6.8	1 18 87	6.95
640	178	"	1.3	10 6	4	6.9	6.9	3 7 82	6.95	12 27 86	6.8	1 18 87	6.95
641	179	"	1.4	6 21	6	7.05	7.0	2 17 82	7.0	3 7 82	7.1	12 27 86	7.1
642	...	"	1.6	22 19	3	6.6	..	3 13 82	6.5	11 26 86	6.65	11 27 87	6.65
643	181	"	3.6	16 43	4	5.5	5.5	1 10 85	5.6	11 26 86	5.45	1 18 87	5.55
644	...	"	3.6	3 54	2	6.8	..	1 3 90	6.8	1 23 90	6.8	.. .. ..	...
645	182	"	3.6	8 14	6	7.1	7.0	3 7 82	6.95	12 27 86	7.0	1 29 89	7.2
646	...	"	3.3	8 16	3	7.2	7.1	3 7 82	7.2	12 27 86	7.2	1 23 90	7.2
647	183	"	4.3	7 15	5	5.85	5.9	3 7 82	5.65	2 24 86	5.8	11 27 86	6.0
648	184	"	4.8	9 9	4	6.05	6.0	3 7 82	5.85	12 27 86	6.0	1 18 87	6.2
649	185	"	5.8	7 10	5	4.15	4.0	3 7 82	4.2	2 22 86	4.4	2 24 86	4.2
650	186	"	5.9	9 10	3	6.65	6.7	3 7 82	6.7	12 27 86	6.6	1 29 89	6.6
651	187	"	6.1	20 41	4	5.75	5.6	3 13 82	5.6	11 26 86	5.75	1 18 87	5.8
652	189	"	6.4	17 36	4	6.7	6.5	1 10 85	6.8	11 26 86	6.75	2 6 88	6.65
653	190	"	7.3	1 28	3	6.75	7.0	2 17 82	6.8	1 18 87	6.8	1 29 89	6.7
654	191	"	7.5	24 9	4	6.7	6.8	3 13 82	6.7	11 26 86	6.7	1 27 87	6.7
655	192	"	7.7	23 27	4	6.7	6.6	3 13 82	6.7	11 26 86	6.65	1 27 87	6.7
656	194	"	8.5	10 34	7	5.15	5.2	3 7 82	5.15	2 22 86	4.95	2 24 86	5.4
657	195	"	9.3	16 30	5	7.0	6.9	1 10 85	6.9	11 26 86	7.1	1 27 87	7.05
658	197	"	9.5	7 51	4	4.65	4 4	3 7 82	4.65	2 22 86	4.7	2 24 86	4.7
659	198	"	9.8	16 46	3	6.85	6.8	1 10 85	6.8	11 26 86	6.9	12 25 88	6.85
660	199	"	10.4	23 33	4	6.65	6.7	3 13 82	6.7	11 26 86	6.6	1 27 87	6.7
661	200	"	10.5	22 28	4	6.8	6.7	3 13 82	6.8	11 26 86	6.75	1 27 87	6.7
662	202	"	10.2	6 47	5	6.4	6.3	3 7 82	6.2	2 24 86	6.4	12 27 86	6.5
663	203	"	12.8	21 1	5	6.35	6.4	3 13 82	6.2	11 26 86	6.3	1 27 87	6.35
664	205	"	13.3	23 17	4	6.2	6.2	3 13 82	6.0	11 26 86	6.3	1 27 87	6.25
665	206	"	13.5	8 25	3	6.95	7.0	3 7 82	6.95	12 27 86	6.9	2 6 88	7.0
666	208	"	14.5	16 44	5	6.75	7.0	1 10 85	6.8	11 26 86	6.65	1 27 87	6.7
667	209	"	14.5	6 33	4	6.6	6.7	3 7 82	6.5	2 24 86	6.7	12 27 86	6.6
668	210	"	14.7	7 54	4	6.05	6.0	3 7 82	5.85	2 24 86	6.1	12 27 86	6.05
669	211	"	15.1	0 23	5	6.4	6.4	2 17 82	6.5	1 27 87	6.45	2 13 87	6.35
670	212	"	15.2	20 56	3	5.4	5.4	3 13 82	5.4	11 26 86	5.35	2 6 88	5.4
671	213	"	15.5	6 35	7	6.65	6.8	3 7 82	6.85	2 24 86	6.7	12 27 86	6.5
672	214	"	16.3	26 1	6	6.1	6.2	3 14 82	5.85	11 26 86	6.2	1 27 87	6.2
673	215	"	17.5	4 2	3	5.5	5.6	2 17 82	5.55	1 27 87	5.5	2 1 89	5.5
674	216	"	17.9	25 11	6	6.3	6.1	3 14 82	6.0	11 26 86	6.3	1 27 87	6.4
675	52	*Tauri*	20.5	+ 1 48	2	6.5	6.5	2 17 82	6.5	2 13 87	6.5	.. .. ..	...
676	221	*Eridani*	21.3	−18 56	5	7.15	7.0	3 14 82	7.3	1 19 87	7.0	1 27 87	7.1
677	53	*Tauri*	21.6	+ 1 35	2	6.5	6.5	2 17 82	6.5	2 13 87	6.5	.. .. ..	...
678	222	*Eridani*	21.7	−24 22	6	6.15	6.2	3 14 82	5.85	11 26 86	6.2	1 27 87	6.2
679	54	*Tauri*	4 22.1	+ 1 6	3	5.95	5.8	2 17 82	6.0	1 27 87	5.9	2 13 87	5.9

No.	U. A. No.	Name	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
680	224	*Eridani*	4 22.4	−15 28	3	6.95	7.0	1 19 87	6.9	1 27 87	7.0	2 1 89	6.95
681	225	"	22.5	21 47	5	6.95	6.9	3 14 82	7.15	11 26 86	6.9	1 27 87	6.9
682	227	"	23.1	19 44	3	6.3	6.4	3 14 82	6.3	1 19 87	6.3	2 1 89	6.3
683	228	"	23.3	13 20	5	5.5	5.7	3 7 82	5.5	2 24 86	5.5	1 19 87	5.3
684	229	"	24.4	13 52	2	6.7	6.7	3 7 82	6.7	1 19 87	6.7	.. .. ..	...
685	230	"	25.3	23 18	6	6.9	6.8	3 14 82	7.15	11 26 86	6.9	1 27 87	6.75
686	231	"	25.5	0 19	4	5.4	5.4	2 17 82	5.3	1 27 87	5.5	2 13 87	5.3
687	232	"	25.7	13 55	3	6.45	6.6	3 7 82	6.45	1 19 87	6.5	2 1 89	6.4
688	234	"	26.4	3 29	2	6.1	6.0	2 27 86	6.1	1 21 87	6.1	.. .. ..	...
689	235	"	27.3	12 49	4	7.05	6.9	3 7 82	6.9	1 19 87	7.05	2 6 88	7.1
690	236	"	27.5	11 3	5	6.25	6.3	3 7 82	6.45	1 19 87	6.2	1 27 87	6.3
691	237	"	27.5	7 15	3	6.9	7.0	3 7 82	6.9	1 19 87	6.95	1 27 87	6.9
692	238	"	27.6	8 31	3	6.85	6.8	3 7 82	6.9	1 19 87	6.8	1 27 87	6.9
693	239	"	27.8	7 0	6	5.8	5.7	3 7 82	6.0	2 24 86	5.6	1 19 87	5.9
694	240	"	28.2	7 6	5	6.4	6.2	3 7 82	6.2	1 19 87	6.55	1 27 87	6.5
695	241	"	28.2	8 30	5	5.45	5.4	3 7 82	5.3	2 24 86	5.6	1 19 87	5.5
696	242	"	28.2	9 14	4	5.55	5.5	3 7 82	5.5	2 24 86	5.55	1 19 87	5.6
697	244	"	29.1	28 43	3	6.95	6.9	3 13 82	6.95	1 19 87	6.9	1 27 87	6.95
698	245	"	29.3	10 0	4	6.35	6.4	3 7 82	6.45	1 19 87	6.2	1 27 87	6.3
699	246	"	29.4	24 18	5	6.75	6.7	3 14 82	6.9	11 26 86	6.65	1 27 87	6.75
700	247	"	29.5	20 11	4	6.55	6.6	3 14 82	6.6	1 19 87	6.4	1 27 87	6.6
701	248	"	29.8	3 52	3	6.65	6.5	2 27 86	6.7	1 21 87	6.6	2 1 89	6.6
702	249	"	30.1	24 48	6	6.9	6.9	3 14 82	7.15	11 26 86	6.9	1 27 87	6.9
703	250	"	30.1	3 37	4	3.85	3.8	3 13 82	3.8	2 22 86	3.9	2 24 86	3.8
704	252	"	31.3	2 43	2	5.7	5.8	2 27 86	5.7	1 21 87	5.7	.. .. ..	...
705	...	"	32.2	13 17	3	6.95	..	2 6 88	7.0	2 9 88	6.95	1 29 89	6.9
706	253	"	32.0	30 58	4	6.5	6.3	3 13 82	6.4	1 19 87	6.5	1 27 87	6.6
707	254	"	32.5	14 33	3	3.8	4.1	3 13 82	3.85	2 24 86	3.8	2 28 86	3.8
708	255	"	33.1	12 22	4	5.3	5.2	3 13 82	5.2	2 24 86	5.4	1 27 87	5.4
709	256	"	33.4	1 18	4	6.65	6.6	2 27 86	6.75	1 21 87	6.6	2 25 87	6.75
710	257	"	33.6	14 36	4	5.65	5.6	3 13 82	5.6	2 24 86	5.5	1 19 87	5.7
711	258	"	34.9	24 44	6	5.75	6.0	3 14 82	5.55	11 26 86	5.8	1 27 87	5.8
712	259	"	35.0	19 55	6	4.8	4.6	3 13 82	4.5	2 24 86	4.75	2 12 87	5.1
713	260	"	35.9	12 43	2	6.8	6.8	3 13 82	6.8	1 19 87	6.8	.. .. ..	...
714	261	"	36.0	1 10	2	7.0	7.0	2 27 86	7.0	1 21 87	7.0	.. .. ..	...
715	262	"	37.6	9 2	7	6.35	6.4	3 13 82	6.9	1 27 87	6.4	2 12 87	6.3
716	263	"	38.1	8 44	6	6.1	5.8	3 13 82	6.5	1 27 87	6.0	2 12 87	5.95
717	12	*Cæli*	38.3	31 0	3	6.25	6.2	3 13 82	6.2	1 19 87	6.3	1 27 87	6.3
718	264	*Eridani*	38.6	18 54	6	5.55	5.7	3 13 82	5.7	2 24 86	5.55	1 19 87	5.8
719	265	"	39.2	27 49	3	6.95	7.0	3 13 82	6.95	1 19 87	7.0	1 27 87	6.95
720	266	"	39.3	3 29	5	3.95	4.0	3 13 82	4.05	2 22 86	4.0	2 24 86	3.8
721	267	"	39.7	21 31	3	6.2	6.1	3 13 82	6.2	1 19 87	6.1	2 1 89	6.3
722	1	*Orionis*	40.2	3 11	5	6.7	6.8	3 17 82	6.6	2 27 86	6.5	2 14 87	6.7
723	268	*Eridani*	41.4	28 19	3	6.3	6.4	3 13 82	6.3	1 19 87	6.3	1 27 87	6.3
724	269	"	42.0	17 10	6	5.7	5.7	3 13 82	5.7	2 24 86	5.7	11 26 86	5.4
725	270	"	42.4	5 53	5	6.2	6.3	3 13 82	6.1	2 28 86	6.1	1 21 87	6.3
726	271	"	42.9	16 33	4	6.0	5.8	3 13 82	6.2	2 24 86	5.9	11 26 86	6.0
727	6	*Orionis*	43.0	+ 6 45	2	3.2	3.1	2 28 86	3.25	2 14 87	3.15	.. .. ..	...
728	16	*Cæli*	43.0	−30 15	4	6.6	6.7	3 13 82	6.7	1 19 87	6.5	1 27 86	6.6
729	272	*Eridani*	44.0	13 59	2	6.5	6.5	3 13 82	6.5	1 27 87	6.5	.. .. ..	...
730	273	"	44.5	16 1	4	7.0	7.0	3 13 82	7.0	11 26 86	6.8	2 9 88	7.0
731	274	"	44.6	16 26	6	5.25	5.0	3 13 82	5.2	2 24 86	5.25	11 26 86	4.95
732	9	*Orionis*	4 44.6	+ 5 23	2	3.6	3.7	2 28 86	3.65	2 14 87	3.6	.. .. ..	...

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs	Mag. Mean Obs'd.	Mag. U A	Separate Observations Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
733	275	*Eridani*	4 46.0	−25 31	5	7.2	6.9	3 14 82	7.3	1 27 87	7.3	2 12 87	7.3
734	276	"	46.8	5 40	7	4.65	4.7	3 13 82	4.7	2 22 86	4.3	2 24 86	4.5
735	277	"	47.8	20 59	2	6.9	6.9	3 13 82	6.9	1 19 87	6.9	.. .. ..	...
736	13	*Orionis*	47.8	+ 2 14	2	3.55	3.7	2 28 86	3.55	2 14 87	3.55	.. .. ..	...
737	16	"	48.2	− 3 26	3	6.8	6.9	3 17 82	6.85	1 21 87	6.75	2 14 87	6.8
738	278	*Eridani*	49.5	16 57	5	6.15	5.7	3 13 82	6.1	2 24 86	6.05	11 26 86	6.25
739	279	"	49.7	16 37	5	6.15	var.	3 13 82	6.1	2 24 86	6.05	11 26 86	6.35
740	280	"	50.3	5 22	4	5.9	5.9	3 13 82	5.8	2 28 86	5.85	1 21 87	5.95
741	1	*Leporis*	50.4	25 56	6	6.7	6.7	3 14 82	7.15	2 12 87	6.6	2 19 87	6.5
742	20	*Orionis*	51.0	1 16	4	6.7	6.5	3 17 82	6.7	1 21 87	6.65	2 6 88	6.85
743	21	"	51.9	2 25	3	6.65	6.7	3 17 82	6.6	1 21 87	6.6	2 1 89	6.7
744	281	*Eridani*	52.0	14 26	3	6.25	6.3	3 13 82	6.2	1 21 87	6.3	2 1 89	6.25
745	2	*Leporis*	52.6	16 58	3	6.75	6.9	3 13 82	6.75	11 26 86	6.8	2 1 89	6.7
746	3	"	53.4	16 34	4	5.95	6.0	3 13 82	6.1	2 24 86	5.9	11 26 86	5.8
747	4	"	53.9	15 0	1	7.4	var.	3 13 82	7.4	.. .. ..	..	.. .. ..	...
748	282	*Eridani*	53.9	10 27	4	5.95	6.0	3 13 82	6.1	1 27 87	5.8	2 12 87	5.9
749	283	"	54.1	12 43	6	5.2	var.	2 22 86	5.0	2 24 86	5.0	2 28 86	5.3
750	25	*Orionis*	54.4	2 15	4	6.7	6.7	3 17 82	6.7	1 21 87	6.65	2 13 88	6.75
751	284	*Eridani*	54.6	5 54	5	6.7	6.7	3 13 82	6.5	1 27 87	6.75	2 12 87	6.7
752	26	*Orionis*	55.1	0 53	4	6.9	6.9	3 17 82	7.0	1 21 87	6.9	3 22 89	6.9
753	285	*Eridani*	55.4	7 22	4	5.15	5.3	3 13 82	5.2	2 24 86	5.0	2 12 87	5.2
754	286	"	55.9	5 41	4	6.8	6.8	3 13 82	6.7	1 27 87	6.75	2 1 89	6.8
755	5	*Leporis*	56.0	20 14	6	5.2	5.5	3 13 82	5.45	2 6 82	5.1	2 24 86	5.1
756	287	*Eridani*	56.6	4 24	3	6.5	6.6	3 13 82	6.5	1 27 87	6.6	2 12 87	6.45
757	6	*Leporis*	57.1	26 27	8	5.45	5.4	2 6 82	5.1	3 13 82	5.2	2 28 86	5.4
758	30	*Orionis*	57.4	2 43	3	7.0	6.9	3 17 82	7.0	1 21 87	7.0	2 1 89	6.95
759	7	*Leporis*	57.5	22 59	3	6.2	6.1	3 13 82	6.1	2 12 87	6.3	2 19 87	6.25
760	8	"	58.2	14 33	3	6.55	6.6	3 13 82	6.5	1 21 87	6.55	2 1 89	6.55
761	9	"	58.2	14 44	4	7.0	7.0	3 13 82	7.1	1 21 87	6.9	2 19 87	7.05
762	10	"	58.7	24 34	3	5.9	5.9	3 13 82	5.9	2 28 86	6.0	2 12 87	5.8
763	31	*Orionis*	58.7	3 13	5	6.4	6.5	3 17 82	6.3	2 28 86	6.4	1 21 87	6.4
764	11	*Leporis*	4 59.4	20 25	4	7.15	7.0	3 13 82	7.05	1 19 87	7.1	2 19 87	7.2
765	12	"	5 0.2	22 32	8	3.35	3.1	2 6 82	3.3	3 14 82	3.3	2 22 86	3.3
766	13	"	0.2	26 19	3	6.1	6.1	3 13 82	6.1	2 28 86	6.0	2 2 89	6.2
767	288	*Eridani*	0.6	4 50	4	5.55	5.6	3 13 82	5.45	2 28 86	5.6	2 25 87	5.65
768	14	*Leporis*	0.8	13 18	4	6.15	6.3	3 13 82	6.2	2 19 87	6.15	2 24 87	6.1
769	289	*Eridani*	1.5	8 49	4	6.95	6.9	3 13 82	6.9	2 12 87	7.0	2 6 88	6.85
770	290	"	1.7	5 15	3	2.8	2.8	2 6 82	2.8	2 22 86	2.9	2 14 87	2.75
771	16	*Leporis*	1.6	12 39	3	6.3	6.3	3 13 82	6.4	2 19 87	6.2	2 22 87	6.35
772	15	"	1.7	19 34	5	6.7	6.6	3 13 82	6.55	1 19 87	6.6	2 2 89	6.7
773	18	"	1.6	17 28	4	7.1	7.0	3 13 82	7.05	2 12 87	7.15	2 19 87	7.05
774	17	"	2.0	12 45	2	6.8	6.8	3 13 82	6.8	2 19 87	6.8	.. .. ..	...
775	...	"	2.2	17 27	3	7.3	7.3	3 13 82	7.2	2 12 87	7.4	2 13 88	7.3
776	291	*Eridani*	2.4	8 50	3	6.5	6.5	3 13 82	6.5	1 27 87	6.45	2 2 89	6.5
777	292	"	2.5	4 37	5	5.7	5.6	3 13 82	5.45	2 28 86	5.8	1 27 87	5.7
778	19	*Leporis*	2.6	15 16	2	6.8	6.7	3 13 82	6.8	1 21 87	6.8	.. .. ..	...
779	293	*Eridani*	3.2	8 55	10	4.35	4.6	2 6 82	4.8	3 13 82	4.6	2 22 86	4.3
780	39	*Orionis*	3.2	2 18	3	6.9	6.8	3 17 82	6.85	1 21 87	6.95	2 14 87	6.9
781	40	"	3.7	0 43	3	6.6	6.5	3 17 82	6.55	2 28 86	6.6	2 1 89	6.6
782	41	"	4.7	2 24	3	6.65	6.6	3 17 82	6.7	1 21 87	6.65	2 1 89	6.65
783	...	*Leporis*	4.7	11 48	4	7.25	7.4	3 13 82	7.15	2 19 87	7.3	2 24 87	7.3
784	42	*Orionis*	5.0	2 39	4	6.4	6.3	3 17 82	6.4	2 28 86	6.4	1 21 87	6.4
785	20	*Leporis*	5 5.6	12 0	5	6.3	6.0	3 13 82	6.0	2 19 87	6.35	2 14 87	6.35

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
786	22	*Leporis*	5 5.7	−26 4	4	6.55	6.6	3 13 82	6.5	1 21 87	6.7	2 19 87	6.5
787	21	"	6.5	12 1	4	4.5	4.4	2 6 82	4.6	3 14 82	4.4	2 22 86	4.5
788	45	*Orionis*	6.7	6 12	3	6.7	6.6	3 14 82	6.65	2 13 87	6.75	2 14 87	6.65
789	23	*Leporis*	7.3	16 21	6	3.1	3.4	2 6 82	3.0	3 14 82	3.2	2 22 86	3.1
790	24	"	7.5	13 6	6	4.35	4.2	2 6 82	4.5	3 14 82	4.2	2 22 86	4.4
791	49	*Orionis*	7.6	8 18	3	6.85	6.8	3 13 82	6.8	3 22 89	6.85	3 23 89	6.85
792	5	*Columbæ*	7.9	27 20	3	6.8	6.7	3 13 82	6.8	1 21 87	6.7	2 2 89	6.85
793	25	*Leporis*	8.3	14 45	3	6.55	6.5	3 13 82	6.6	1 21 87	6.55	2 2 89	6.55
794	50	*Orionis*	8.5	8 21	2	1.0	1.0	2 28 86	1.0	2 14 87	1.0	.. .. ..	...
795	52	"	9.0	1 33	3	6.6	6.5	3 17 82	6.55	2 28 86	6.6	2 1 89	6.6
796	26	*Leporis*	9.5	26 21	2	7.0	7.0	3 13 82	7.0	1 21 87	7.0	.. .. ..	...
797	27	"	10.3	11 30	5	6.85	6.7	3 13 82	6.9	2 19 87	6.7	2 24 87	6.8
798	7	*Columbæ*	10.3	28 29	2	6.8	7.0	3 13 82	6.8	1 21 87	6.8	.. .. ..	...
799	28	*Leporis*	10.4	27 5	6	5.2	5.4	2 6 82	5.1	3 13 82	5.55	2 28 86	5.1
800	29	"	10.5	23 2	3	6.95	6.9	3 13 82	7.0	2 12 87	6.9	2 2 89	6.9
801	30	"	11.3	17 17	3	6.65	6.7	3 13 82	6.6	2 28 86	6.6	1 21 87	6.7
802	54	*Orionis*	11.5	6 59	3	3.85	3.9	2 6 82	3.8	2 22 86	3.9	3 7 86	3.8
803	31	*Leporis*	11.9	17 55	3	6.8	7.0	3 13 82	6.75	2 28 86	6.8	1 21 87	6.8
804	32	"	11.9	15 21	3	6.8	6.8	3 13 82	6.8	1 21 87	6.85	2 2 89	6.8
805	33	"	11.9	13 39	4	6.05	6.0	3 13 82	5.95	2 19 87	6.0	2 2 89	6.2
806	34	"	13.3	18 16	4	6.3	6.4	3 13 82	6.3	2 28 86	6.4	1 21 87	6.4
807	56	*Orionis*	13.3	1 33	3	6.55	6.7	3 17 82	6.55	2 28 86	6.6	2 1 89	6.5
808	35	*Leporis*	13.8	18 39	4	6.0	6.1	3 13 82	6.0	2 28 86	6.1	1 21 87	6.1
809	36	"	13.8	13 18	6	4.25	4.1	2 6 82	4.5	3 14 82	4.1	2 22 86	4.2
810	37	"	14.2	12 27	4	5.85	5.7	3 13 82	5.8	2 22 86	5.85	2 24 86	5.8
811	58	*Orionis*	14.3	5 30	3	6.7	6.7	3 14 82	6.65	2 13 87	6.75	2 14 87	6.7
812	12	*Columbæ*	14.4	27 30	4	6.0	6.1	3 14 82	6.0	2 28 86	6.0	1 21 87	6.0
813	38	*Leporis*	15.1	21 22	4	4.95	4.9	2 6 82	5.0	3 13 82	5.1	2 24 86	4.75
814	60	*Orionis*	15.2	0 33	3	6.6	6.7	3 15 82	6.6	2 13 87	6.65	2 1 89	6.55
815	61	"	15.4	0 30	4	5.15	5.1	3 15 82	5.05	2 28 86	5.1	2 22 87	5.2
816	39	*Leporis*	16.1	13 53	4	6.9	6.9	3 13 82	6.8	2 13 87	6.9	2 19 87	6.9
817	40	"	16.4	17 44	4	6.8	6.6	3 13 82	6.75	2 28 86	6.8	1 21 87	6.9
818	41–2	"	16.6	24 54	3	5.4	5.4	3 13 82	5.55	2 28 86	5.3	2 12 87	5.4
819	64	*Orionis*	17.3	0 17	4	6.25	6.2	3 15 82	6.4	2 28 86	6.25	2 22 87	6.2
820	65	"	17.3	8 32	2	6.6	6.6	3 14 82	6.6	2 13 87	6.6	.. .. ..	...
821	66	"	17.5	0 59	4	6.85	6.9	3 15 82	6.9	2 13 87	6.7	2 22 87	6.75
822	43	*Leporis*	17.8	14 3	5	5.6	5.7	3 13 82	5.5	2 22 86	5.55	2 24 86	5.6
823	68	*Orionis*	17.9	7 55	4	4.6	4.4	2 6 82	4.4	2 22 86	4.7	3 7 86	4.7
824	67	"	18.1	1 1	3	5.65	5.6	3 15 82	5.65	2 28 86	5.6	2 14 87	5.7
825	44	*Leporis*	18.2	26 50	3	6.5	6.5	3 13 82	6.5	1 21 87	6.6	2 2 89	6.45
826	70	*Orionis*	18.2	2 31	4	3.4	3.4	2 6 82	3.3	2 22 86	3.4	1 3 89	3.55
827	72	"	18.4	+ 6 14	2	1.7	1.7	2 6 82	1.8	2 28 86	1.6	.. .. ..	...
828	45	*Leporis*	18.9	−17 5	3	6.0	5.9	3 13 82	6.1	2 28 86	5.95	1 21 87	6.0
829	73	*Orionis*	19.1	10 27	2	6.5	6.4	3 14 82	6.5	2 22 87	6.5	.. .. ..	...
830	46	*Leporis*	19.6	12 40	6	6.9	6.9	3 13 82	6.8	2 13 87	6.9	2 19 87	6.95
831	75	*Orionis*	19.9	5 38	4	6.55	6.6	3 14 82	6.7	2 13 87	6.65	3 23 89	6.45
832	47	*Leporis*	20.6	19 48	3	6.15	6.2	3 13 82	6.1	1 21 87	6.15	2 2 89	6.15
833	48	"	21.3	12 0	3	6.6	6.6	3 13 82	6.6	3 14 82	6.6	2 13 87	6.65
834	49	"	22.3	21 29	3	6.6	6.5	3 13 82	6.6	2 12 87	6.55	2 2 89	6.6
835	50	"	22.4	26 41	2	7.0	6.9	3 13 82	7.0	1 21 87	7.0	.. .. ..	...
836	...	*Orionis*	22.7	3 24	3	6.9	..	2 13 87	6.9	2 13 88	6.85	2 29 88	7.0
837	51	*Leporis*	22.9	20 52	6	2.95	2.9	2 6 82	2.7	3 14 82	3.0	2 22 86	3.0
838	79	*Orionis*	5 23.2	3 33	4	6.5	6.5	3 17 82	6.4	2 13 87	6.6	2 14 87	6.45

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° '									
839	80	*Orionis*	5 23.4	− 7 22	4	6.9	6.8	3 14 82	6.8	2 13 87	6.85	3 22 89	6.95
840	81	"	23.4	1 12	9	5.7	var.	3 15 82	5.3	2 28 86	5.7	2 13 87	5.9
841	85	"	24.3	7 32	3	6.8	6.9	3 14 82	6.7	2 13 87	6.85	2 14 87	6.8
842	21	*Columbæ*	24.3	30 13	3	6.9	6.9	3 14 82	7.0	2 12 87	6.9	2 2 89	6.8
843	52	*Leporis*	24.4	22 49	3	6.95	7.0	3 13 82	7.0	2 12 87	6.95	2 2 89	6.95
844	87	*Orionis*	25.3	6 48	4	6.8	6.7	3 14 82	6.7	2 13 87	6.75	3 22 89	6.95
845	88	"	25.6	0 24	3	2.3	2.3	2 6 82	2.3	2 22 86	2.25	2 14 87	2.35
846	53	*Leporis*	25.8	20 57	5	5.95	5.9	3 13 82	5.8	2 12 87	6.0	2 19 87	6.0
847	89	*Orionis*	25.9	7 24	3	5.0	5.1	2 6 82	5.1	2 22 86	4.9	3 7 86	5.0
848	90	"	26.2	0 5	9	6.95	6.6	3 17 82	6.65	2 13 87	7.0	2 14 87	7.0
849	91	"	26.4	1 41	4	6.0	6.1	3 15 82	6.0	2 28 86	5.95	2 13 87	6.1
850	92	"	27.2	1 15	6	6.25	6.1	3 15 82	6.1	2 28 86	6.25	2 13 87	6.3
851	54	*Leporis*	27.2	17 55	7	2.7	2.7	2 6 82	2.4	3 14 82	2.85	2 22 86	2.85
852	93	*Orionis*	27.7	1 7	8	6.75	7.0	3 15 82	7.0	2 13 87	6.7	2 14 87	6.7
853	96	"	27.8	1 33	4	6.7	6.5	3 15 82	6.6	2 13 87	6.7	3 23 89	6.8
854	99	"	28.1	0 6	3	7.0	7.0	3 17 82	7.0	2 13 87	7.0	3 24 89	6.95
855	100	"	28.2	4 54	7	7.15	6.8	2 19 82	7.35	2 13 87	7.1	2 14 87	7.2
856	104	"	29.1	5 28	3	5.1	5.0	3 19 82	5.15	2 28 86	5.1	3 23 89	5.1
857	27	*Columbæ*	29.1	29 56	3	6.45	6.6	3 14 82	6.4	2 12 87	6.5	2 13 88	6.45
858	106	*Orionis*	29.2	4 31	3	6.95	6.8	2 19 82	7.0	2 13 87	6.9	3 23 89	6.95
859	...	"	29.2	4 35	5	7.0	7.1	2 19 82	6.85	2 13 87	7.1	2 14 87	7.05
860	109	"	29.2	4 55	5	5.5	5.5	2 19 82	5.5	2 28 86	5.3	2 13 87	5.7
861	105	"	29.3	5 30	5	5.6	5.2	2 19 82	5.5	2 28 86	5.7	2 14 87	5.5
862	107	"	29.3	4 27	3	6.95	6.8	2 19 82	7.0	2 13 87	6.9	3 23 89	6.95
863	108	"	29.3	6 0	4	2.85	2.9	2 6 82	2.8	2 22 86	2.7	3 23 89	2.85
864	110	"	29.5	4 56	3	6.05	6.1	2 19 82	6.0	2 28 86	6.1	2 13 87	6.05
865	111	"	29.4	3 20	33	6.75	6.8	3 17 82	6.65	2 13 87	6.7	2 13 88	6.8
866	55	*Leporis*	29.8	15 49	3	6.85	6.9	3 13 82	6.9	2 12 87	6.9	2 13 88	6.8
867	112	*Orionis*	29.9	1 17	4	1.9	1.8	2 6 82	1.8	2 22 86	1.9	2 14 87	2.0
868	115	"	30.5	6 9	5	6.5	6.6	2 19 82	6.35	2 13 87	6.3	2 14 87	6.5
869	117	"	31.3	6 1	4	6.7	6.8	2 19 82	6.85	2 13 87	6.5	2 14 87	6.75
870	30	*Columbæ*	31.3	28 47	2	6.4	6.5	3 14 82	6.4	2 12 87	6.4	.. .. ..	...
871	56	*Leporis*	31.3	11 51	3	6.45	6.5	3 14 82	6.5	2 13 87	6.45	2 2 89	6.4
872	118	*Orionis*	31.7	4 54	3	6.75	6.7	2 19 82	6.85	2 13 87	6.65	2 14 87	6.75
873	32	*Columbæ*	32.3	27 57	3	6.4	6.4	3 14 82	6.4	2 12 87	6.35	2 2 89	6.5
874	119	*Orionis*	32.5	2 40	3	4.05	4.0	2 6 82	4.0	2 22 86	4.1	3 23 89	4.1
875	120	"	32.6	6 39	6	6.4	6.6	2 19 82	6.0	2 13 87	6.45	2 22 87	6.4
876	122	"	32.8	7 17	4	5.2	5.2	2 6 82	5.1	2 22 86	5.2	3 7 86	5.35
877	34	*Columbæ*	32.9	28 46	5	5.55	5.3	3 14 82	5.4	2 28 86	5.8	2 12 87	5.6
878	35	"	33.1	27 17	3	6.9	6.8	3 14 82	7.0	2 12 87	6.8	2 13 88	6.9
879	123	*Orionis*	33.3	3 38	5	6.6	6.7	3 17 82	6.5	2 28 86	6.7	2 13 87	6.7
880	124	"	33.6	9 47	2	6.7	6.7	3 14 82	6.7	2 13 87	6.7	.. .. ..	...
881	57	*Leporis*	33.8	17 55	3	6.35	6.4	3 13 82	6.3	2 12 87	6.4	2 13 88	6.3
882	125	*Orionis*	34.4	2 54	2	6.8	6.8	3 17 82	6.8	2 13 87	6.8	.. .. ..	...
883	126	"	34.5	2 1	4	1.8	1.8	2 6 82	1.8	2 22 86	1.8	2 28 86	1.85
884	127	"	34.5	1 12	8	5.6	5.7	3 17 82	6.0	2 28 86	5.3	2 13 87	5.55
885	129	"	34.9	10 29	5	6.55	6.6	3 14 82	6.4	2 13 87	6.55	2 14 87	6.6
886	58	*Leporis*	35.3	20 22	3	6.85	6.7	3 13 82	6.8	2 19 87	6.85	2 2 89	6.85
887	130	*Orionis*	35.4	2 58	2	6.8	6.7	3 17 82	6.8	2 13 87	6.8	.. .. ..	...
888	59	*Leporis*	36.1	16 47	4	6.5	6.5	3 13 82	6.6	2 12 87	6.4	2 19 87	6.4
889	60	"	36.7	17 36	4	6.7	6.7	3 13 82	6.65	2 12 87	6.75	2 19 87	6.75
890	133	*Orionis*	36.8	1 40	3	6.9	6.8	3 17 82	6.9	2 13 87	6.85	3 22 89	7.0
891	134	"	5 36.8	6 52	8	6.45	6.4	3 19 82	6.0	2 13 87	6.6	2 14 87	6.6

No	U. A No.	Name.	1875.		No. Obs.	Mag.		Separate Observations.					
			R. A.	Decl.		Mean Obs'd.	U A.	Date.	Mag	Date.	Mag.	Date.	Mag.
			h. m.	° '									
892	61	*Leporis*	5 37.0	−22 26	4	6.3	6.4	3 13 82	6.3	2 19 87	6.25	2 13 88	6.4
893	41	*Columbæ*	37.4	30 36	3	6.35	6.4	3 14 82	6.3	2 13 87	6.4	2 13 88	6.4
894	62	*Leporis*	37.9	18 37	3	6.1	6.0	3 13 82	6.1	2 12 87	6.1	2 13 88	6.05
895	63	"	39.1	20 11	3	6.75	6.7	3 13 82	6.8	2 19 87	6.7	2 2 89	6.75
896	64	"	39.3	22 29	7	3.55	3.5	2 6 82	3.8	3 14 82	3.4	2 22 86	3.4
897	65	"	39.5	21 43	3	6.95	7.0	3 13 82	6.9	2 19 87	7.0	2 2 89	6.9
898	136	*Orionis*	39.9	4 19	4	6.8	6.8	3 19 82	6.8	2 13 87	6.85	2 14 87	6.8
899	44	*Columbæ*	40.5	31 43	3	6.85	6.8	3 14 82	6.8	2 13 87	6.9	2 2 89	6.85
900	66	*Leporis*	41.3	14 52	5	3.5	3.6	2 6 82	3.3	3 14 82	3.6	2 19 87	3.6
901	67	"	41.5	16 17	4	6.6	6.6	3 14 82	6.5	2 12 87	6.6	2 13 88	6.7
902	140	*Orionis*	41.6	10 35	3	6.5	6.6	3 14 82	6.4	2 13 87	6.6	2 14 87	6.5
903	141	"	41.8	9 43	4	2.2	2.3	2 6 82	2.1	2 14 87	2.25	3 13 87	2.3
904	...	"	42.2	8 26	4	7.1	7.0	3 14 82	6.9	2 13 87	7.1	2 22 87	7.1
905	46	*Columbæ*	42.2	28 41	2	6.2	6.2	3 14 82	6.2	2 12 87	6.2	.. .. ..	...
906	142	*Orionis*	42.4	4 8	4	6.4	6.5	3 19 82	6.35	2 13 87	6.4	2 13 88	6.4
907	68	*Leporis*	43.0	14 21	3	6.85	6.8	3 14 82	6.8	2 19 87	6.9	2 2 89	6.9
908	69	"	43.9	14 31	3	5.95	5.8	3 14 82	5.9	2 19 87	5.95	3 1 89	6.0
909	70	"	44.7	23 1	3	6.2	6.2	3 13 82	6.2	2 19 87	6.2	2 2 89	6.2
910	51	*Columbæ*	45.2	30 40	3	6.75	6.8	3 14 82	6.8	2 13 87	6.7	2 2 89	6.75
911	146	*Orionis*	45.3	7 33	5	5.95	5.9	3 14 82	6.2	3 7 86	5.8	2 13 87	5.95
912	71	*Leporis*	45.9	20 53	9	3.9	3.7	2 6 82	4.1	3 14 82	3.6	2 22 86	3.6
913	148	*Orionis*	46.2	9 5	3	6.35	6.4	3 14 82	6.4	2 13 87	6.35	3 23 89	6.35
914	72	*Leporis*	46.3	22 58	3	6.65	6.5	3 13 82	6.6	2 19 87	6.65	2 2 89	6.65
915	..	"	46.4	15 32	4	7.2	7.1	3 14 82	7.1	2 19 87	7.1	1 14 90	7.3
916	54	*Columbæ*	47.2	29 29	4	6.75	6.7	3 14 82	6.8	2 12 87	6.8	2 13 87	6.7
917	151	*Orionis*	48.4	4 5	3	6.8	6.8	3 19 82	6.8	2 13 87	6.85	3 23 89	6.8
918	152	"	48.4	+ 7 23	2	1.2	var.	2 28 86	1.1	2 14 87	1.3	.. .. ..	...
919	73	*Leporis*	48.6	−19 40	3	6.75	6.7	3 13 82	6.8	2 19 87	6.7	2 2 89	6.75
920	74	"	48.9	11 48	3	6.25	6.3	3 14 82	6.2	2 19 87	6.2	3 23 89	6.3
921	153	*Orionis*	49.3	4 51	4	7.45	7.5	3 19 82	7.45	2 13 87	7.45	2 13 88	7.45
922	154	"	49.3	4 38	6	6.0	6.0	3 19 82	5.75	2 13 87	6.05	2 22 87	6.25
923	...	"	49.4	4 49	6	6.65	6.5	3 19 82	7.0	2 13 87	6.6	2 25 87	6.6
924	58	*Columbæ*	49.4	29 10	3	6.5	6.4	3 14 82	6.5	2 12 87	6.5	2 13 87	6.45
925	75	*Leporis*	49.7	26 41	3	6.95	7.0	3 13 82	6.95	2 19 87	7.0	2 2 89	6.9
926	...	"	50.6	21 42	3	7.0	—	2 29 88	7.0	2 2 89	7.0	3 23 89	7.0
927	76	"	50.7	14 12	5	3.75	3.8	2 6 82	4.1	3 14 82	3.8	2 19 87	3.5
928	77	"	50.9	21 9	4	7.0	7.0	3 13 82	6.95	2 19 87	7.0	2 2 89	7.0
929	78	"	51.0	22 52	3	6.45	6.4	3 13 82	6.4	2 19 87	6.5	2 13 88	6.4
930	79	"	51.4	23 14	4	6.7	6.7	3 13 82	6.6	2 19 87	6.8	2 24 87	6.8
931	157	*Orionis*	51.8	1 1	5	6.7	6.6	3 19 82	6.4	3 6 85	6.7	2 13 87	6.8
932	80	*Leporis*	52.1	18 4	4	6.9	6.9	3 13 82	6.95	2 19 87	6.8	2 25 87	6.9
933	1	*Monocerotis*	53.1	9 24	3	6.95	7.0	3 14 82	7.0	2 13 87	6.9	3 23 89	6.9
934	2	"	53.1	9 34	3	5.85	5.7	3 14 82	5.85	2 13 87	5.9	3 23 89	5.85
935	160	*Orionis*	53.3	1 27	5	6.7	6.8	3 19 82	6.55	3 6 85	6.7	2 13 87	6.8
936	161	"	53.8	3 5	7	5.35	5.2	3 17 82	4.9	2 28 86	5.55	2 13 87	5.5
937	81	*Leporis*	54.5	12 54	2	6.5	6.6	3 14 82	6.5	2 19 87	6.5	.. .. ..	...
938	3	*Monocerotis*	56.0	10 36	3	5.4	5.6	3 14 82	5.35	2 13 87	5.45	3 23 89	5.4
939	82	*Leporis*	56.1	25 25	3	6.25	6.3	3 13 82	6.2	2 19 87	6.3	2 2 89	6.2
940	83	"	56.9	14 30	4	6.8	6.7	3 13 82	6.9	2 19 87	6.7	2 24 87	6.7
941	4	*Monocerotis*	58.2	6 42	4	5.7	5.8	3 14 82	5.8	2 28 86	5.65	2 13 87	5.7
942	84	*Leporis*	58.2	26 17	3	5.6	5.5	3 13 82	5.6	2 28 86	5.6	2 19 87	5.55
943	166	*Orionis*	58.4	1 34	3	6.9	6.9	3 19 82	6.9	2 13 87	6.8	3 23 89	6.95
944	85	*Leporis*	5 59.4	16 29	10	5.45	5.5	2 6 82	5.1	3 13 82	5.5	2 27 86	5.5

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag	Date.	Mag.	Date.	Mag
			h. m.	° ′									
945	5	*Monocerotis*	5 59.6	−10 14	3	6.5	6.4	3 14 82	6.5	2 13 87	6.4	3 23 89	6.55
946	86	*Leporis*	6 0.5	14 56	5	5.2	5.2	2 6 82	5.0	3 13 82	5.2	2 27 86	5.3
947	6	*Monocerotis*	0.5	4 11	3	5.75	5.9	3 17 82	5.8	2 28 86	5.8	2 13 87	5.7
948	87	*Leporis*	0.6	24 11	..	var.	6.9	3 13 82	6.95	2 19 87	6.7	2 24 87	6.9
949	167	*Orionis*	0.7	3 20	4	6.95	7.0	3 19 82	7.0	2 13 87	6.85	2 22 87	6.9
950	7	*Monocerotis*	0.9	6 11	3	6.9	7.0	3 14 82	6.9	3 24 84	6.95	2 13 87	6.9
951	88	*Leporis*	1.0	11 10	3	6.95	6.9	3 14 82	7.0	2 13 87	7.0	1 20 90	6.8
952	89-90	"	1.3	23 6	3	5.7	5.8	3 13 82	5.75	2 28 86	5.7	2 19 87	5.7
953	74	*Columbæ*	1.3	29 45	2	5.9	5.9	3 14 82	5.9	2 13 87	5.9	.. .. ..	...
954	91	*Leporis*	1.7	21 48	4	6.35	6.3	3 13 82	6.2	2 19 87	6.35	2 24 87	6.5
955	92	"	2.3	19 9	4	5.95	5.9	3 13 82	5.8	2 19 87	6.1	2 24 87	6.0
956	93	"	2.6	11 8	5	7.0	7.0	3 14 82	7.0	2 13 87	7.05	2 13 88	7.1
957	8	*Monocerotis*	2.7	6 48	3	6.9	6.9	3 14 82	7.0	2 13 87	6.9	3 23 89	6.85
958	9	"	2.8	7 55	4	6.9	6.9	3 14 82	7.0	2 13 87	6.8	2 24 87	6.9
959	10	"	3.1	8 17	5	6.95	6.8	3 14 82	7.0	2 13 87	6.8	2 24 87	7.0
960	11	"	3.5	5 42	2	6.7	6.5	3 14 82	6.7	2 13 87	6.7	.. .. ..	...
961	94	*Leporis*	3.7	22 24	3	5.75	5.8	3 13 82	5.75	2 28 86	5.8	2 19 87	5.75
962	95	"	3.9	18 6	3	6.65	6.7	3 13 82	6.7	2 19 87	6.65	3 23 89	6.65
963	96	"	3.9	14 34	5	6.25	6.0	3 13 82	6.05	2 19 87	6.2	2 24 87	6.3
964	97	"	4.6	22 45	4	5.95	5.9	3 13 82	5.9	2 28 86	5.9	2 19 87	6.05
965	98	"	4.6	15 2	5	7.0	7.0	3 13 82	7.1	2 19 87	7.05	2 13 88	6.9
966	99	"	4.8	26 41	2	6.6	6.6	3 13 82	6.6	2 19 87	6.6	.. .. ..	...
967	12	*Monocerotis*	5.0	6 44	3	6.65	6.7	3 14 82	6.55	2 13 87	6.75	2 19 87	6.6
968	100	*Leporis*	5.6	27 8	4	6.3	6.0	3 13 82	6.2	2 19 87	6.3	2 13 88	6.35
969	13	*Monocerotis*	5.6	4 38	4	6.5	6.6	3 17 82	6.4	2 13 87	6.7	2 19 87	6.5
970	101	*Leporis*	5.8	15 46	2	6.9	6.9	3 13 82	6.9	2 19 87	6.9	.. .. ..	...
971	14	*Monocerotis*	5.8	6 31	4	5.8	5.9	3 14 82	6.0	2 28 86	5.7	2 13 87	5.8
972	102	*Leporis*	6.2	26 27	3	6.35	6.4	3 13 82	6.2	2 19 87	6.45	2 24 87	6.35
973	103	"	6.2	18 10	5	7.05	7.0	3 13 82	6.9	2 19 87	7.0	2 13 88	7.1
974	174	*Orionis*	6.5	2 29	3	6.7	6.7	3 19 82	6.7	3 6 85	6.6	2 13 87	6.8
975	...	*Monocerotis*	7.0	8 42	2	6.95	..	2 24 87	6.95	2 13 88	6.95	.. .. ..	...
976	1	*Canis Majoris*	7.3	17 44	3	6.75	6.8	3 13 82	6.7	2 19 87	6.8	3 29 88	6.75
977	175	*Orionis*	7.7	3 43	2	6.4	6.3	3 17 82	6.4	2 13 87	6.4	.. .. ..	...
978	2	*Canis Majoris*	7.8	15 21	6	7.0	7.0	3 13 82	7.1	2 19 87	7.05	2 24 87	7.05
979	15	*Monocerotis*	8.4	4 32	3	6.15	6.2	3 17 82	6.25	2 28 86	6.1	2 13 87	6.1
980	3	*Canis Majoris*	8.7	29 22	5	6.7	6.8	3 14 82	6.7	2 13 87	6.6	2 19 87	6.8
981	16	*Monocerotis*	8.8	6 14	2	4.5	4.3	3 17 82	4.5	2 25 87	4.5	.. .. ..	...
982	178	*Orionis*	9.2	0 28	8	6.2	6.1	3 19 82	6.55	3 6 85	6.2	2 13 87	6.3
983	17	*Monocerotis*	9.3	4 53	7	6.3	6.3	3 17 82	6.4	2 28 86	6.1	2 13 87	6.6
984	18	"	9.5	9 0	4	6.45	6.7	3 14 82	6.4	2 13 87	6.45	3 26 87	6.5
985	4	*Canis Majoris*	9.7	29 34	4	6.9	6.9	3 14 82	6.9	2 13 87	6.9	2 19 87	6.9
986	5	"	9.8	20 14	3	6.45	6.5	3 14 82	6.5	2 19 87	6.45	3 24 89	6.45
987	6	"	9.8	18 26	5	6.5	6.6	3 13 82	6.4	2 19 87	6.55	2 22 87	6.6
988	8	"	9.6	11 52	3	6.8	6.7	3 17 82	6.8	2 24 87	6.85	3 24 89	6.75
989	7	"	10.0	13 41	3	5.4	5.5	3 17 82	5.4	2 27 86	5.5	2 19 87	5.35
990	9	"	10.6	16 35	4	6.35	6.5	3 14 82	6.5	2 19 87	6.2	2 24 87	6.3
991	...	"	10.9	12 0	4	7.1	7.1	3 17 82	6.9	2 24 87	7.15	3 26 87	7.15
992	...	"	11.1	29 45	3	7.0	..	2 13 87	7.05	2 19 87	6.9	2 13 88	7.05
993	10	"	11.8	22 40	3	6.45	6.6	3 14 82	6.5	2 24 87	6.45	2 13 88	6.45
994	11	"	12.1	16 46	3	5.95	5.8	3 14 82	5.9	2 19 87	6.0	2 13 88	5.9
995	12	"	12.3	19 9	5	7.0	6.9	3 14 82	7.2	2 19 87	7.0	3 13 87	7.0
996	13	"	12.8	19 55	2	5.8	5.8	3 14 82	5.8	2 19 87	5.8	.. .. ..	...
997	19	*Monocerotis*	6 12.9	9 20	3	6.1	6.0	3 14 82	6.1	2 13 87	6.1	3 23 89	6.15

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
998	20	*Monocerotis*	6 13.2	− 8 32	3	6.55	6.8	3 14 82	6.55	2 13 87	6.55	3 23 89	6.6
999	14	*Canis Majoris*	13.2	14 59	3	6.7	6.7	3 17 82	6.7	2 19 87	6.65	2 24 87	6.8
1000	15	"	13.7	20 53	2	6.1	6.2	3 14 82	6.1	2 19 87	6.1	.. .. ..	...
1001	185	*Orionis*	13.7	2 54	7	5.8	5.5	3 17 82	5.3	2 28 86	5.9	2 13 87	5.9
1002	21	*Monocerotis*	13.7	7 46	5	5.8	5.9	3 14 82	6.0	2 28 86	5.7	2 13 87	5.8
1003	...	*Canis Majoris*	13.8	24 58	4	7.25	7.1	3 14 82	7.1	2 24 87	7.3	2 13 88	7.35
1004	...	"	14.2	24 55	3	7.35	7.4	3 14 82	7.3	2 24 87	7.35	2 13 88	7.35
1005	16	"	14.4	22 3	5	6.9	6.9	3 14 82	6.7	2 24 87	6.85	2 13 87	6.9
1006	18	"	15.5	30 1	5	3.2	3.2	2 6 82	3.4	3 14 82	3.0	2 27 86	3.2
1007	17	"	15.6	11 43	5	6.05	6.1	3 17 82	6.1	2 27 86	5.85	2 22 87	6.1
1008	19	"	16.1	29 37	4	6.95	6.9	3 14 82	7.0	2 13 87	6.9	2 19 87	6.9
1009	24	*Monocerotis*	16.8	3 13	3	7.0	7.0	3 17 82	7.0	2 25 87	7.0	3 20 87	7.0
1010	27	"	17.2	4 38	3	6.9	7.0	3 17 82	7.0	2 25 87	6.85	3 20 87	6.9
1011	20	*Canis Majoris*	17.2	17 54	3	2.1	2.2	2 6 82	2.0	3 14 82	2.1	2 13 88	2.2
1012	21	"	18.1	15 0	2	6.9	6.9	3 17 82	6.9	2 24 87	6.9	.. .. ..	...
1013	22	"	18.1	16 24	4	6.8	6.8	3 17 82	6.7	2 24 87	6.8	2 13 88	6.9
1014	23	"	18.4	11 28	4	5.85	5.6	3 17 82	5.9	2 27 86	5.7	2 24 87	5.8
1015	24	"	18.4	19 43	3	6.9	6.9	3 14 82	6.85	2 24 87	6.9	3 24 89	6.9
1016	26	"	18.6	12 54	3	6.4	6.5	3 17 82	6.3	2 24 87	6.5	3 13 87	6.4
1017	27	"	18.7	29 48	5	7.0	7.0	3 14 82	7.1	2 13 87	7.05	2 19 87	7.0
1018	28	"	18.8	16 10	4	7.0	6.9	3 17 82	7.1	2 24 87	6.95	3 13 87	7.0
1019	29	"	18.9	25 31	3	6.15	6.0	3 14 82	6.15	2 24 87	6.2	2 29 88	6.15
1020	30	*Monocerotis*	18.9	0 52	2	6.4	6.3	3 19 82	6.4	2 25 87	6.4	.. .. ..	...
1021	32	"	19.3	2 55	4	6.8	6.7	3 17 82	6.7	2 25 87	6.85	3 20 87	6.9
1022	33	"	19.6	3 49	3	6.8	6.7	3 17 82	6.7	2 25 87	6.85	3 20 87	6.8
1023	34	"	19.9	3 27	4	6.85	6.8	3 17 82	6.7	2 20 87	6.9	2 25 87	6.85
1024	30	*Canis Majoris*	19.9	28 42	4	6.7	6.7	3 14 82	6.6	2 13 87	6.7	2 19 87	6.7
1025	35	*Monocerotis*	20.0	7 50	4	6.8	6.9	3 17 82	6.65	2 13 87	6.8	2 24 87	6.8
1026	36	"	20.3	1 26	3	6.25	6.3	3 19 82	6.2	2 25 87	6.3	3 23 89	6.3
1027	38	"	20.4	4 32	3	6.5	6.7	3 17 82	6.5	2 25 87	6.5	3 20 87	6.5
1028	40	"	20.7	7 26	4	6.8	6.7	3 17 82	6.9	2 13 87	6.7	2 24 87	6.75
1029	...	"	20.8	4 23	3	7.4	7.2	3 17 82	7.3	2 25 87	7.5	2 13 88	7.4
1030	39	"	20.8	4 17	3	6.8	6.9	3 17 82	6.8	2 25 87	6.85	3 20 87	6.8
1031	43	"	20.9	0 12	5	6.25	6.1	3 19 82	6.1	2 25 87	6.3	3 20 87	6.3
1032	31	*Canis Majoris*	20.9	29 38	4	6.85	6.9	3 14 82	6.7	2 13 87	6.9	2 19 87	6.9
1033	32	"	21.0	14 32	3	6.85	6.8	3 17 82	6.8	2 24 87	6.9	3 24 89	6.9
1034	45	*Monocerotis*	21.8	4 41	4	5.5	5.4	3 17 82	5.5	2 28 86	5.45	2 25 87	5.4
1035	33	*Canis Majoris*	22.2	25 46	2	6.4	6.5	3 14 82	6.4	2 24 87	6.4	.. .. ..	...
1036	...	"	22.2	13 5	4	7.2	7.1	3 17 82	7.1	3 13 87	7.2	3 24 89	7.3
1037	...	*Monocerotis*	22.4	0 30	2	6.95	7.1	3 19 82	6.95	2 25 87	6.95	.. .. ..	...
1038	48	"	22.8	6 57	5	4.1	4.1	3 17 82	4.4	2 25 87	4.1	3 20 87	3.9
1039	34	*Canis Majoris*	23.1	17 23	2	6.6	6.5	3 14 82	6.6	2 24 87	6.6	.. .. ..	...
1040	37	"	24.2	22 31	3	7.0	7.0	3 14 82	7.0	3 17 82	7.0	2 24 87	7.0
1041	50	*Monocerotis*	24.3	10 0	6	6.65	6.4	3 17 82	6.45	2 13 87	6.6	2 24 87	6.7
1042	38	*Canis Majoris*	24.8	19 8	3	7.0	7.0	3 14 82	7.0	3 17 82	7.0	2 24 87	7.0
1043	39	"	24.8	13 4	3	6.5	6.7	3 17 82	6.5	2 24 87	6.4	2 29 88	6.55
1044	40	"	24.8	14 52	3	7.0	7.0	3 17 82	7.1	2 24 87	6.95	3 13 87	6.95
1045	41	"	25.6	12 18	3	5.7	5.6	3 17 82	5.7	2 27 86	5.7	2 24 87	5.7
1046	42	"	25.8	27 41	3	6.1	6.1	3 14 82	6.15	2 13 87	6.2	3 24 89	6.0
1047	53	*Monocerotis*	25.8	8 4	2	6.0	6.0	3 17 82	6.0	2 13 87	6.0	.. .. ..	...
1048	43	*Canis Majoris*	26.2	21 19	3	6.85	6.8	3 14 82	6.8	3 17 82	6.9	2 24 87	6.9
1049	55	*Monocerotis*	26.3	5 47	3	6.05	6.0	3 17 82	6.1	2 28 86	6.0	2 25 87	6.1
1050	44	*Canis Majoris*	6 26.7	23 20	8	4.4	4.5	3 14 82	4.7	3 6 85	4.4	2 22 86	4.25

No.	U. A. No.	Name.	1875.		No. Obs.	Mag.		Separate Observations.					
			R. A.	Decl.		Mean Obs'd.	U. A.	Date.	Mag.	Date.	Mag.	Date	Mag
			h. m.	° ′									
1051	46	*Canis Majoris*	6 26.9	−11 5	4	6.85	6.8	3 17 82	6.7	2 24 87	6.95	3 13 87	6.85
1052	56	*Monocerotis*	27.3	1 8	3	5.65	5.7	3 19 82	5.7	2 25 87	5.6	3 23 89	5.6
1053	48	*Canis Majoris*	28.1	20 50	3	6.85	6.8	3 14 82	6.8	3 17 82	6.9	2 24 87	6.9
1054	49	"	29.8	22 52	5	4.75	4.8	3 14 82	4.85	3 6 85	4.8	2 22 86	4.5
1055	51	"	30.2	22 1	4	6.9	6.9	3 14 82	7.0	3 17 82	6.8	2 24 87	6.85
1056	59	*Monocerotis*	30.4	5 7	3	5.9	5.9	3 17 82	5.9	2 28 86	5.9	2 25 87	5.9
1057	52	*Canis Majoris*	30.9	18 34	3	6.4	6.4	3 14 82	6.4	2 24 87	6.45	3 24 89	6.3
1058	53	"	31.0	13 13	3	6.75	6.8	3 17 82	6.7	2 24 87	6.8	3 24 89	6.7
1059	54	"	31.2	19 9	6	4.3	4.1	3 14 82	4.3	3 6 85	4.2	2 22 86	4.2
1060	55	"	31.4	22 31	4	6.8	6.8	3 14 82	6.8	3 17 82	6.7	2 24 87	6.7
1061	56	"	31.9	12 52	3	6.7	6.6	3 17 82	6.6	2 24 87	6.8	3 13 87	6.7
1062	63	*Monocerotis*	32.1	2 26	2	6.7	6.6	3 19 82	6.7	2 25 87	6.7	. . . . . .	. . .
1063	57	*Canis Majoris*	32.4	18 8	10	4.95	4.9	3 14 82	4.5	3 6 85	5.0	2 22 86	4.7
1064	58	"	33.0	16 46	2	6.6	6.6	3 14 82	6.6	3 13 87	6.6	. . . . . .	. . .
1065	60	"	33.2	23 28	3	6.85	6.9	3 14 82	6.8	3 13 87	6.9	3 24 89	6.9
1066	61	"	33.6	14 2	8	5.55	5.3	3 17 82	5.3	2 22 86	5.8	2 27 86	5.3
1067	62	"	34.4	23 35	3	6.55	6.6	3 14 82	6.6	3 13 87	6.5	3 24 89	6.5
1068	68	*Monocerotis*	36.0	9 3	2	5.7	5.7	3 17 82	5.7	2 24 87	5.7	. . . . . .	. . .
1069	64	*Canis Majoris*	36.1	20 12	8	7.15	7.0	3 14 82	7.0	3 17 82	7.0	3 13 87	7.1
1070	. . .	"	36.6	20 8	6	7.25	7.2	3 14 82	7.2	3 17 82	7.2	3 13 87	7.15
1071	70	*Monocerotis*	36.6	4 1	5	6.95	7.0	3 19 82	7.05	2 25 87	7.0	3 4 88	6.95
1072	65	*Canis Majoris*	37.5	22 20	3	6.65	6.7	3 14 82	6.6	3 13 87	6.65	3 24 89	6.65
1073	72	*Monocerotis*	39.5	0 35	5	7.05	7.0	3 19 82	6.9	2 25 87	7.0	3 20 87	7.0
1074	68	*Canis Majoris*	39.9	27 14	6	6.7	6.8	3 14 82	6.5	2 28 87	6.8	3 13 87	6.8
1075	69	"	40.2	23 20	5	6.75	6.6	3 14 82	6.6	3 13 87	6.75	3 26 87	6.85
1076	71	"	40.3	14 40	8	5.6	5.7	3 17 82	5.75	2 22 86	5.3	2 27 86	5.3
1077	75	*Monocerotis*	40.7	9 59	7	5.8	6.1	3 17 82	6.2	2 24 87	5.9	3 20 87	5.6
1078	75	*Canis Majoris*	41.2	14 18	5	5.4	5.5	3 17 82	5.6	2 22 86	5.3	2 27 86	5.3
1079	77	*Monocerotis*	41.6	8 52	6	5.75	5.6	3 17 82	5.5	2 24 87	5.65	3 20 87	5.8
1080	76	*Canis Majoris*	41.7	20 53	3	6.4	6.6	3 17 82	6.4	3 24 84	6.4	3 13 87	6.4
1081	78	*Monocerotis*	42.0	1 11	3	6.2	6.2	3 19 82	6.2	2 25 87	6.2	3 20 87	6.2
1082	80	"	43.0	2 8	3	6.15	6.1	3 19 82	6.1	2 25 87	6.2	3 20 87	6.1
1083	77	*Canis Majoris*	43.3	15 0	3	5.8	5.8	3 17 82	5.75	2 27 86	5.9	3 13 87	5.7
1084	82	*Monocerotis*	44.4	0 23	4	6.3	6.3	3 19 82	6.4	2 25 87	6.2	3 20 87	6.2
1085	78	*Canis Majoris*	44.6	23 56	5	6.65	6.6	3 14 82	6.9	2 28 87	6.6	3 13 87	6.5
1086	83	*Monocerotis*	44.7	7 54	5	6.55	6.6	3 17 82	6.7	2 24 87	6.55	3 20 87	6.55
1087	. . .	*Canis Majoris*	44.7	17 9	4	7.1	7.1	3 17 82	7.2	4 13 87	7.1	3 23 89	7.0
1088	79	"	44.8	16 56	6	6.65	6.4	3 17 82	6.35	3 26 87	6.7	4 13 87	6.6
1089	80	"	45.1	27 11	4	7.1	7.0	3 14 82	7.1	2 28 87	7.1	3 13 87	7.1
1090	. . .	*Monocerotis*	45.4	6 49	3	6.8	. . .	3 20 87	6.8	3 23 87	6.8	3 4 88	6.75
1091	82	*Canis Majoris*	45.5	25 38	5	6.6	6.6	3 14 82	6.4	2 28 87	6.6	3 13 87	6.6
1092	. . .	"	45.5	20 46	3	7.0	7.1	3 17 82	7.0	2 29 88	7.0	1 20 90	7.0
1093	87	*Monocerotis*	46.2	5 2	3	6.85	6.9	3 19 82	6.8	2 25 87	6.9	3 23 89	6.85
1094	88	"	46.2	5 10	3	6.85	6.7	3 19 84	6.8	2 25 87	6.9	3 23 89	6.85
1095	84	*Canis Majoris*	47.9	18 53	3	6.4	6.1	3 17 82	6.4	3 13 87	6.4	3 24 89	6.4
1096	85	"	47.9	18 47	2	6.8	6.8	3 17 82	6.8	3 13 87	6.8	. . . . . .	. . .
1097	86	"	48.0	26 48	4	7.0	7.0	3 14 82	6.9	2 28 87	7.0	3 13 87	7.0
1098	89	*Monocerotis*	48.0	5 42	5	6.75	6.7	3 19 82	6.5	2 25 87	6.9	3 13 87	6.75
1099	90	"	48.1	0 58	3	5.9	5.9	3 19 82	5.9	2 25 87	5.85	3 20 87	5.9
1100	87	*Canis Majoris*	48.2	20 4	5	5.05	5.3	3 14 82	5.1	2 22 86	5.15	2 27 86	5.0
1101	88	"	48.2	24 32	4	6.85	6.9	3 14 82	6.9	2 28 87	6.85	3 13 87	6.8
1102	89	"	48.4	11 53	3	4.6	4.4	3 17 82	4.6	2 22 86	4.65	2 27 86	4.6
1103	91	"	6 48.4	1 36	3	6.55	6.7	3 19 82	6.6	2 25 87	6.5	3 20 87	6.55

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
1104	90	*Canis Majoris*	6 48.6	−28 22	5	6.55	6.5	3 14 82	6.4	2 28 87	6.5	3 13 87	6.6
1105	92	*Monocerotis*	48.7	2 39	4	6.5	6.4	3 19 82	6.4	2 25 87	6.5	3 20 87	6.55
1106	91	*Canis Majoris*	48.8	24 23	3	6.8	6.6	3 14 82	6.9	2 28 87	6.7	3 13 87	6.8
1107	92	"	49.0	24 2	6	4.15	3.9	2 6 82	3.75	3 14 82	4.0	2 22 86	4.0
1108	94	"	49.7	20 15	3	6.35	6.5	3 17 82	6.4	3 13 87	6.3	3 4 88	6.4
1109	95	"	50.2	19 59	5	5.1	4.9	3 14 82	5.0	2 22 86	5.05	2 27 86	5.0
1110	96	"	50.4	13 53	3	5.55	5.5	3 17 82	5.5	2 22 86	5.6	2 27 86	5.6
1111	97	"	50.5	22 47	3	5.85	5.9	3 14 82	5.8	3 13 87	5.95	4 13 87	5.75
1112	98	"	50.6	16 54	6	4.8	4.9	3 14 82	5.0	3 17 82	4.9	2 22 86	4.8
1113	94	*Monocerotis*	51.0	8 1	4	6.6	6.5	3 17 82	6.5	2 24 87	6.6	3 23 89	6.7
1114	100	*Canis Majoris*	51.6	19 16	4	7.05	7.0	3 17 82	7.0	3 13 87	7.0	1 20 90	7.1
1115	101	"	52.0	22 2	3	6.95	6.9	3 17 82	6.9	3 13 87	7.0	3 24 89	7.0
1116	196	*Monocerotis*	52.2	10 9	4	7.1	7.0	3 17 82	7.1	2 24 87	7.05	3 20 87	7.2
1117	102	*Canis Majoris*	52.4	24 28	3	6.1	5.9	3 14 82	6.1	2 28 87	6.1	3 13 87	6.1
1118	103	"	52.7	27 22	4	6.55	6.6	3 14 82	6.4	2 28 87	6.6	3 13 87	6.55
1119	104	"	53.1	27 0	3	6.6	6.6	3 14 82	6.7	2 28 87	6.6	3 13 87	6.55
1120	105	"	53.5	25 15	4	6.0	6.0	3 14 82	6.1	2 28 87	6.0	3 13 87	5.9
1121	106	"	53.7	28 48	4	1.7	1.8	2 6 82	1.7	3 14 82	1.8	2 22 86	1.65
1122	100	*Monocerotis*	54.2	5 12	4	6.75	6.9	3 19 84	6.9	2 25 87	6.7	3 20 87	6.65
1123	107	*Canis Majoris*	54.3	21 26	2	6.7	6.7	3 17 82	6.7	3 13 87	6.7	. . . . . .	. . .
1124	101	*Monocerotis*	54.4	8 14	2	6.3	6.2	3 17 82	6.3	2 24 87	6.3	. . . . . .	. . .
1125	102	"	54.7	9 2	3	6.7	6.7	3 17 82	6.7	2 24 87	6.7	3 4 88	6.7
1126	111	*Canis Majoris*	54.7	19 59	3	6.65	6.6	3 17 82	6.6	3 13 87	6.7	3 24 89	6.7
1127	. . .	"	55.0	21 57	3	6.9	. . .	3 13 87	6.9	3 4 88	6.85	3 17 90	6.9
1128	112	"	55.2	20 28	3	6.85	6.9	3 17 82	6.9	3 13 87	6.8	3 24 89	6.8
1129	105	*Monocerotis*	55.5	1 10	3	6.8	6.6	3 19 82	6.8	2 25 87	6.7	3 23 89	6.85
1130	106	"	55.8	5 33	7	6.1	5.6	3 19 82	5.7	2 25 87	6.0	3 20 87	6.2
1131	113	*Canis Majoris*	56.0	25 24	3	6.0	6.0	3 14 82	6.1	2 28 87	5.9	3 13 87	6.0
1132	. . .	"	56.0	11 7	3	7.0	. . .	2 24 87	7.0	1 21 90	7.0	2 11 90	7.0
1133	114	"	56.7	27 45	5	4.05	3 6	3 14 82	3.7	2 22 86	4.2	2 27 86	3.9
1134	108	*Monocerotis*	56.7	4 4	4	5.45	5.5	3 19 82	5.5	2 25 87	5.35	3 20 87	5.45
1135	115	*Canis Majoris*	57.8	23 39	5	3.4	3.4	3 14 82	3.3	3 22 84	3.4	2 22 86	3.4
1136	110	*Monocerotis*	57.9	5 8	5	6.3	6.2	3 19 82	6.1	2 25 87	6.4	3 20 87	6.35
1137	111	"	58.0	9 56	3	6.75	6.8	3 17 82	6.7	2 24 87	6.75	3 4 88	6.75
1138	116	*Canis Majoris*	58.1	15 27	5	4.25	4.5	3 17 82	4.25	2 22 86	4.3	2 27 86	4.0
1139	117	"	59.5	21 51	3	6.75	6.7	3 17 82	6.7	3 13 87	6.8	3 4 88	6.8
1140	113	*Monocerotis*	6 59.9	10 28	3	6.75	6.7	3 17 82	6.7	2 24 87	6.75	3 4 88	6.75
1141	119	*Canis Majoris*	7 0.8	11 6	3	5.95	6.0	3 17 82	5.9	2 24 87	6.0	3 4 88	5.95
1142	118	"	0.8	12 12	4	6.8	7.0	3 17 82	7.0	2 24 87	6.8	3 26 87	6.8
1143	121	"	1.7	24 46	3	6.8	6.7	3 17 82	6.7	3 13 87	6.9	3 4 88	6.8
1144	122	"	2.2	23 39	3	6.55	6.3	3 17 82	6.5	3 13 87	6.5	3 4 88	6.6
1145	123	"	3.3	26 12	4	2.3	2.1	2 6 82	2.3	3 14 82	2.3	2 22 86	2.3
1146	114	*Monocerotis*	3.4	10 9	4	6.6	6.6	3 17 82	6.5	2 24 87	6.6	3 4 88	6.65
1147	124	*Canis Majoris*	3.6	23 51	4	6.95	7.0	3 17 82	7.05	3 13 87	6.9	3 4 88	6.8
1148	125	"	3.9	16 2	3	6.5	6.6	3 19 82	6.6	3 24 87	6.45	3 26 87	6.5
1149	115	*Monocerotis*	4.0	4 3	4	5.5	5.4	3 19 82	5.3	2 25 87	5.5	3 20 87	5.65
1150	126	*Canis Majoris*	4.6	25 2	3	6.2	6.3	3 17 82	6.2	3 13 87	6.1	3 4 88	6.25
1151	127	"	4.7	18 29	4	6.75	6.8	3 19 82	6.9	3 24 87	6.7	3 26 87	6.75
1152	116	*Monocerotis*	4.8	3 42	4	6.95	6.9	3 19 82	7.1	2 25 87	7.0	3 6 88	6.9
1153	117	"	5.0	0 6	4	6.0	6.0	3 19 82	6.2	2 25 87	5.8	3 20 87	6.0
1154	128	*Canis Majoris*	5.3	27 17	4	6.4	6.3	3 17 82	6.35	3 13 87	6.3	3 4 88	6.5
1155	118	*Monocerotis*	5.5	0 17	5	4.4	4.6	3 19 82	4.7	2 25 87	4.6	4 2 88	4.2
1156	129	*Canis Majoris*	7 5.9	17 8	4	6.8	6.8	3 19 82	6.7	3 24 87	6.75	3 4 88	6.9

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No Obs	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h m.	° ′									
1157	130	*Canis Majoris*	7 6.3	−20 41	3	6.5	6.3	3 17 82	6.4	3 24 87	6.6	3 26 87	6.5
1158	131	"	7.1	25 44	3	6.55	6.5	3 17 82	6.6	3 13 87	6.5	3 4 88	6.5
1159	132	"	7.3	11 3	4	6.4	6.4	3 17 82	6.3	2 24 87	6.5	3 26 87	6.3
1160	119	*Monocerotis*	8.0	3 41	6	6.6	6.7	3 19 82	6.4	2 25 87	6.4	3 6 88	6.65
1161	134	*Canis Majoris*	8.1	22 28	3	6.8	6.8	3 17 82	6.75	3 13 87	6.8	3 24 89	6.8
1162	120	*Monocerotis*	8.3	9 44	4	6.45	6.3	3 17 82	6.3	2 24 87	6.5	3 20 87	6.45
1163	135	*Canis Majoris*	8.5	22 42	2	6.8	6.9	3 17 82	6.8	3 13 87	6.8	.. .. ..	...
1164	136	"	8.6	27 9	3	6.75	6.8	3 17 82	6.7	3 13 87	6.8	3 4 88	6.75
1165	121	*Monocerotis*	8.6	10 6	3	6.25	6.3	3 17 82	6.2	2 24 87	6.25	3 4 88	6.25
1166	139	*Canis Majoris*	9.2	26 8	5	5.4	5.4	3 17 82	5.6	2 22 86	5.3	3 7 86	5.4
1167	140	"	9.7	26 33	6	4.15	4.2	3 14 82	4.2	2 22 86	4.15	2 27 86	3.7
1168	141	"	9.8	26 49	4	6.7	6.5	3 17 82	6.6	3 13 87	6.8	3 26 87	6.7
1169	122	*Monocerotis*	9.8	22 22	5	6.45	6.3	3 17 82	6.2	2 24 87	6.5	3 13 87	6.45
1170	143	*Canis Majoris*	10.6	23 31	3	6.75	6.8	3 17 82	6.75	3 13 87	6.8	3 4 88	6.7
1171	144	"	10.6	15 22	3	6.15	5.9	3 19 82	6.1	3 24 87	6.2	3 4 88	6.1
1172	145-6	"	11.4	23 6	9	5.35	5.0	3 17 82	5.0	2 22 86	5.5	2 27 86	5.3
1173	123	*Monocerotis*	11.4	6 28	3	6.85	6.8	3 19 82	6.8	2 25 87	6.85	3 23 89	6.9
1174	147	*Canis Majoris*	11.6	27 40	6	5.45	5.4	3 17 82	5.3	3 13 87	5.45	4 17 87	5.5
1175	149	"	12.7	26 34	4	6.95	7.0	3 17 82	7.0	3 13 87	6.9	4 19 87	7.0
1176	150	"	13.5	24 20	5	5.4	5.6	2 22 86	5.3	3 17 86	5.4	3 4 88	5.55
1177	151	"	13.5	24 44	5	4.6	4.6	3 17 82	4.7	2 22 86	4.65	2 27 86	4.4
1178	152	"	13.6	19 3	4	6.7	6.6	3 19 82	6.7	3 24 87	6.6	3 4 88	6.75
1179	153	"	13.7	17 18	6	7.0	7.0	3 19 82	6.9	3 24 87	7.0	3 4 88	6.95
1180	154	"	13.8	26 22	3	5.95	6.0	3 17 82	5.9	3 13 87	6.0	3 4 88	5.95
1181	155	"	13.8	16 10	3	var.	6.2	3 19 82	6.4	3 24 87	6.3	3 4 88	6.4
1182	156	"	15.3	14 8	4	6.25	6.2	3 19 82	6.4	3 24 87	6.2	3 26 87	6.15
1183	124	*Monocerotis*	15.3	8 38	3	6.8	6.8	3 19 82	6.75	2 25 87	6.8	3 22 89	6.75
1184	125	"	15.5	5 40	3	6.8	6.9	3 19 82	6.8	2 25 87	6.85	3 23 89	6.8
1185	157	*Canis Majoris*	15.6	22 37	3	7.0	7.0	3 17 82	7.05	3 23 87	7.0	3 4 88	7.0
1186	158	"	15.9	26 44	6	6.5	6.7	3 17 82	6.6	3 13 87	6.6	4 19 87	6.6
1187	159	"	15.9	25 40	3	6.85	6.7	3 17 82	6.9	3 13 87	6.8	3 4 88	6.8
1188	126	*Monocerotis*	16.0	2 45	4	6.5	6.6	3 19 82	6.4	2 25 87	6.6	3 20 87	6.45
1189	127	"	16.0	8 45	4	6.6	6.6	3 19 82	6.6	2 25 87	6.65	3 22 89	6.75
1190	128	"	16.1	0 1	3	6.8	7.0	3 19 82	6.7	2 25 87	6.85	3 20 87	6.8
1191	129	"	16.3	5 45	2	6.1	6.2	3 19 82	6.1	2 25 87	6.1	.. .. ..	...
1192	160	*Canis Majoris*	16.7	18 47	4	5.55	5.7	3 19 82	5.4	3 24 87	5.6	3 26 87	5.55
1193	162	"	18.5	27 36	5	6.15	6.1	3 17 82	6.0	3 13 87	6.3	4 3 87	6.2
1194	164	"	19.0	22 40	3	6.75	6.8	3 17 82	6.9	3 23 87	6.7	3 4 88	6.7
1195	165	"	19.0	15 57	3	5.85	6.0	3 19 82	5.8	3 24 87	5.9	3 4 88	5.85
1196	166	"	19.0	29 59	3	7.0	6.9	3 13 87	6.9	3 23 87	7.05	4 19 87	7.0
1197	167	"	19.2	29 4	5	2.85	2.9	2 6 82	2.85	3 14 82	2.7	3 22 84	3.0
1198	168	"	19.3	18 46	4	6.75	6.8	3 19 82	6.7	3 24 87	6.7	4 6 88	6.85
1199	169	"	19.4	13 30	5	6.45	6.4	3 19 82	6.6	3 24 87	6.45	4 13 87	6.35
1200	170	"	19.7	20 56	4	7.1	6.9	3 19 82	7.0	3 23 87	7.1	4 13 87	7.15
1201	130	*Monocerotis*	19.7	5 32	4	6.45	6.4	3 19 82	6.35	2 25 87	6.5	3 20 87	6.45
1202	131	"	19.9	4 17	3	6.8	6.9	3 19 82	6.8	2 25 87	6.85	3 23 89	6.75
1203	172	*Canis Majoris*	20.0	21 44	5	6.7	6.7	3 19 82	6.6	3 23 87	6.7	3 4 88	6.7
1204	132	*Monocerotis*	20.2	0 13	2	6.9	6.9	3 19 82	6.9	2 25 87	6.9	.. .. ..	...
1205	173	*Canis Majoris*	20.3	24 58	4	6.3	6.4	3 17 82	6.2	3 13 87	6.2	3 4 88	6.4
1206	175	"	21.4	23 28	4	7.0	7.0	3 17 82	6.9	3 23 87	7.0	3 4 88	7.0
1207	176	"	21.6	17 37	5	6.3	6.2	3 19 82	6.4	3 24 87	6.3	3 4 88	6.2
1208	177	"	21.7	22 50	5	6.05	5.7	3 17 82	5.9	3 7 86	5.85	3 23 87	6.2
1209	178	"	7 22.0	11 18	3	6.25	6.3	3 24 87	6.35	4 13 87	6.25	3 22 89	6.1

No.	U. A No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U.A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
1210	...	*Canis Majoris*	7 22.1	−18 15	3	6.95	...	3 24 87	6.9	4 13 87	6.9	2 11 90	7.0
1211	92	*Puppis*	22.4	22 36	2	6.7	6.7	3 17 82	6.7	3 23 87	6.7	.. .. ..	...
1212	133	*Monocerotis*	22.6	9 47	3	6.8	7.0	3 19 82	6.8	2 25 87	6.8	3 22 89	6.75
1213	134	"	23.0	1 39	3	6.2	6.0	3 19 82	6.2	2 25 87	6.2	3 23 89	6.2
1214	93	*Puppis*	23.0	28 54	4	6.15	6.3	3 19 82	6.2	4 13 87	6.0	4 19 87	6.2
1215	135	*Monocerotis*	23.4	7 18	3	6.4	6.3	3 19 82	6.4	2 25 87	6.45	3 22 89	6.4
1216	136	"	23.4	10 4	4	6.45	6.2	3 19 82	6.3	2 25 87	6.45	3 20 87	6.55
1217	...	*Puppis*	23.7	28 52	3	7.15	7.1	3 19 82	7.2	4 19 87	7.15	3 28 89	7.15
1218	94	"	23.7	14 44	3	6.75	6.8	3 19 82	6.7	3 24 87	6.8	3 4 88	6.7
1219	97	"	24.6	22 46	5	5.5	5.7	3 17 82	5.3	3 7 86	5.6	3 23 87	5.45
1220	137	*Monocerotis*	24.7	4 58	5	6.7	6.6	3 19 82	6.6	2 25 87	6.75	3 20 87	6.75
1221	138	"	24.7	1 54	5	7.05	6.8	3 19 82	7.05	2 25 87	7.1	3 20 87	7.2
1222	139	"	24.8	9 31	2	var.	var.	3 19 82	6.6	3 25 87	6.5	.. .. ..	...
1223	140	"	24.9	0 52	3	6.9	6.8	3 19 82	6.9	2 25 87	6.9	3 23 89	6.9
1224	141	"	25.0	9 51	5	7.0	6.9	3 19 82	7.0	2 25 87	6.95	3 22 89	7.05
1225	142	"	26.1	8 37	5	6.3	6.3	3 19 82	6.4	2 25 87	6.35	3 7 88	6.2
1226	143	"	26.5	1 46	4	6.75	6.9	3 19 82	6.7	2 25 87	6.7	3 20 87	6.8
1227	105	*Puppis*	27.8	19 9	5	6.35	6.2	3 19 82	6.3	3 24 87	6.4	3 7 88	6.4
1228	106	"	27.9	24 27	4	6.5	6.7	3 19 82	6.4	4 13 87	6.45	3 7 88	6.55
1229	107	"	28.1	14 15	6	5.3	5.2	3 19 82	4.8	3 24 87	5.2	4 13 87	5.3
1230	108	"	28.7	22 2	4	5.1	5.2	3 19 82	5.15	3 7 86	5.1	3 23 87	5.0
1231	109	"	28.8	19 52	5	7.05	7.0	3 19 82	7.0	3 24 87	7.1	4 17 87	7.05
1232	111-2	"	29.0	23 12	5	5.7	5.7	3 19 82	5.8	3 7 86	5.7	3 23 87	5.7
1233	114	"	29.3	25 51	4	7.0	7.0	3 19 82	6.9	3 24 87	7.0	3 7 88	7.0
1234	116	"	29.5	26 45	6	6.55	6.6	3 19 82	6.2	3 24 87	6.7	4 13 87	6.6
1235	144	*Monocerotis*	30.2	8 2	4	6.8	6.7	3 19 82	6.75	2 25 87	6.9	3 20 87	6.8
1236	122	*Puppis*	30.3	14 13	4	6.35	6.0	3 19 82	6.4	3 24 87	6.4 .	3 7 88	6.2
1237	119	"	30.4	28 6	6	5.2	5.3	3 19 82	5.5	3 7 86	5.2	3 23 87	5.1
1238	120	"	30.4	26 21	5	6.95	7.0	3 19 82	6.8	3 24 87	7.0	4 13 87	7.0
1239	123	"	30.9	14 13	3	6.95	7.0	3 19 82	6.9	3 24 87	7.0	3 29 88	6.95
1240	145	*Monocerotis*	31.1	3 50	2	5.7	5.7	3 19 82	5.7	2 25 87	5.7	.. .. ..	...
1241	125	*Puppis*	31.2	19 26	4	6.1	6.2	3 19 82	6.1	3 24 87	6.1	3 7 88	6.0
1242	146	*Monocerotis*	31.8	6 41	3	6.95	6.9	3 19 82	7.0	2 25 87	6.95	3 22 89	6.95
1243	124	*Puppis*	31.9	14 10	3	6.95	7.0	3 19 82	6.9	3 24 87	7.0	3 29 88	6.9
1244	126	"	32.0	23 30	6	7.0	6.9	3 19 82	6.65	4 19 87	7.15	3 29 88	7.0
1245	128	"	33.1	25 5	5	5.35	5.4	3 19 82	5.5	3 7 86	5.2	3 23 87	5.4
1246	132	"	33.6	18 24	5	6.9	6.8	3 19 82	6.9	3 24 87	6.9	3 7 88	6.9
1247	133-4	"	33.7	26 31	5	3.9	4.0	3 22 84	3.8	3 7 86	3.9	3 23 87	3.95
1248	147	*Monocerotis*	33.7	3 18	5	7.1	7.0	3 19 82	7.1	3 20 87	7.1	3 23 89	7.0
1249	135	*Puppis*	33.8	16 34	4	6.95	7.0	3 19 82	7.0	3 24 87	6.9	3 7 88	7.0
1250	139	"	34.3	26 35	5	7.1	6.9	3 19 82	7.2	3 24 87	7.1	3 29 88	7.1
1251	...	"	34.4	26 38	5	7.3	7.2	3 19 82	7.6	3 24 87	7.2	3 29 88	7.1
1252	148	*Monocerotis*	34.6	7 54	3	6.3	6.3	3 19 82	6.3	2 25 87	6.25	3 7 88	6.35
1253	140	*Puppis*	34.7	14 59	7	5.45	5.4	3 19 82	5.1	3 24 87	5.3	4 19 87	5.7
1254	141	"	34.7	19 22	5	6.6	6.7	3 22 84	6.6	3 24 87	6.6	3 7 88	6.6
1255	149	*Monocerotis*	35.3	9 16	4	4.2	4.0	4 27 84	4.2	2 25 87	4.3	3 7 88	4.1
1256	147	*Puppis*	35.5	29 48	3	6.9	6.8	3 23 82	6.9	4 19 87	6.85	3 30 89	6.8
1257	149	"	36.0	22 3	3	7.05	6.9	4 19 87	7.0	4 27 87	7.0	3 30 89	7.1
1258	151	"	37.2	29 54	3	7.0	7.0	3 23 82	7.05	4 19 87	7.0	3 30 89	7.0
1259	152	"	37.4	16 46	5	7.05	7.0	3 22 84	7.2	3 24 87	6.9	4 13 87	7.1
1260	150	*Monocerotis*	37.4	4 25	5	6.55	6.6	3 19 82	6.4	3 20 87	6.7	3 26 87	6.5
1261	154	*Puppis*	37.7	26 3	4	6.5	6.5	3 23 82	6.45	3 24 87	6.5	3 7 88	6.6
1262	155	"	7 38.5	28 7	8	5.55	5.0	3 23 82	5.0	3 7 86	5.55	3 23 87	5.7

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
1263	157	*Puppis*	7 38.8	−28 39	5	4.35	4.2	3 23 82	4.5	3 7 86	4.25	3 23 87	4.35
1264	158	"	39.0	23 36	2	6.9	7	3 23 82	6.9	4 19 87	6.9	.. .. ..	...
1265	151	*Monocerotis*	39.0	4 9	4	7.0	6.9	3 19 82	7.0	3 20 87	7.0	3 7 88	6.95
1266	161	*Puppis*	39.3	24 23	3	6.3	6.4	3 23 82	6.3	3 24 87	6.3	3 7 88	6.3
1267	152	*Monocerotis*	39.6	5 23	4	7.0	7.0	3 19 82	7.0	3 20 87	7.0	3 7 88	6.95
1268	166	*Puppis*	39.7	14 23	4	6.2	6.4	3 22 84	6.2	3 24 87	6.1	3 29 88	6.1
1269	153	*Monocerotis*	39.9	6 28	4	6.15	6.1	3 19 82	6.05	2 25 87	6.2	3 20 87	6.1
1270	167	*Puppis*	40.2	14 16	2	5.4	5.5	3 22 84	5.4	3 24 87	5.4	.. .. ..	...
1271	168	"	40.6	23 57	3	7.0	7.0	3 23 82	6.9	3 29 88	7.1	3 30 89	7.05
1272	...	"	40.7	22 50	4	7.35	7.2	3 23 82	7.5	4 19 87	7.2	3 29 88	7.4
1273	...	"	40.7	22 57	4	7.6	7.5	3 23 82	7.7	4 19 87	7.5	3 29 88	7.6
1274	170	"	40.9	12 22	5	6.85	6.9	3 22 84	6.8	4 17 87	6.9	3 29 88	6.85
1275	178	"	41.8	22 13	3	6.45	6.5	3 23 82	6.45	4 19 87	6.4	4 19 89	6.45
1276	179	"	42.1	15 42	4	6.6	6.8	3 22 84	6.6	4 17 87	6.55	3 29 88	6.7
1277	180	"	42.1	11 53	4	6.05	5.9	3 22 84	6.1	4 17 87	6.1	3 29 88	6.0
1278	...	*Monocerotis*	42.2	6 28	5	7.0	...	3 20 87	7.0	3 26 87	6.95	3 7 88	7.0
1279	183	*Puppis*	42.9	25 38	6	5.15	5.3	3 23 82	5.25	3 7 86	5.2	3 23 87	5.1
1280	186	"	43.7	13 2	4	6.8	6.8	3 22 84	6.7	4 17 87	6.8	3 29 88	6.7
1281	188	"	43.8	24 36	3	6.3	6.3	3 23 82	6.2	4 19 87	6.4	4 24 87	6.3
1282	190	"	44.0	16 55	3	5.95	5.7	3 22 84	6.0	3 7 86	5.9	4 2 88	5.95
1283	191	"	44.0	24 33	4	3.55	3.5	3 22 84	3.7	3 7 86	3.55	3 23 87	3.5
1284	193	"	44.2	19 12	3	6.95	6.9	3 22 84	7.0	4 19 87	6.9	4 2 88	7.0
1285	154	*Monocerotis*	44.2	8 52	4	6.25	6.2	3 22 84	6.2	3 20 87	6.25	3 7 88	6.35
1286	192	*Puppis*	44.3	19 53	4	6.9	6.9	3 22 84	6.8	4 19 87	6.9	4 2 88	7.0
1287	194	"	44.6	19 13	3	6.75	6.7	3 22 84	6.8	4 19 87	6.7	4 2 88	6.75
1288	155	*Monocerotis*	45.0	10 49	4	6.75	6.7	3 22 84	6.8	3 20 87	6.65	3 26 87	6.9
1289	202	*Puppis*	45.7	24 13	2	6.9	7.0	3 23 82	6.9	3 24 87	6.9	.. .. ..	...
1290	203	"	45.8	12 30	4	6.85	6.8	3 22 84	6.8	4 17 87	6.9	3 29 88	6.85
1291	205	"	46.0	13 35	5	5.65	5.7	4 17 87	5.55	4 19 87	5.75	4 24 87	5.7
1292	204	"	46.3	20 51	4	6.3	6.2	3 22 84	6.4	4 19 87	6.2	4 24 87	6.35
1293	206	"	46.6	14 32	4	6.1	6.1	3 22 84	6.1	4 17 87	6.1	3 29 88	6.1
1294	156	*Monocerotis*	46.6	5 6	4	6.2	6.4	4 27 84	6.3	2 25 87	6.1	3 20 87	6.2
1295	...	*Puppis*	48.3	22 52	5	7.3	7.2	3 23 82	7.05	4 19 87	7.3	4 2 88	7.5
1296	...	"	48.3	22 59	5	7.35	7.4	3 23 82	7.3	4 19 87	7.3	4 2 88	7.5
1297	221	"	51.4	29 57	2	6.85	6.8	3 23 82	6.85	4 19 87	6.85	.. .. ..	...
1298	222	"	51.5	22 33	4	4.8	4.9	3 23 82	4.75	3 7 86	4.85	4 6 88	4.95
1299	225	"	52.7	30 0	3	5.5	5.5	3 23 82	5.5	3 22 84	5.5	3 29 88	5.5
1300	157	*Monocerotis*	53.5	3 20	3	5.55	5.6	4 27 84	5.6	2 25 87	5.5	3 7 88	5.55
1301	230	*Puppis*	53.7	22 58	2	5.85	5.9	3 23 82	5.85	4 19 87	5.85	.. .. ..	...
1302	232	"	54.3	18 3	2	5.3	5.2	3 22 84	5.3	3 7 86	5.3	.. .. ..	...
1303	158	*Monocerotis*	54.5	2 32	3	6.85	6.9	4 27 84	6.9	3 26 87	6.8	3 7 88	6.8
1304	159	"	54.9	1 3	3	5.3	5.2	4 27 84	5.3	2 25 87	5.35	3 23 89	5.3
1305	160	"	54.9	6 5	3	6.8	6.8	4 27 84	6.8	3 20 87	6.9	3 7 88	6.7
1306	161	"	56.3	5 59	3	6.7	6.6	4 27 84	6.8	3 20 87	6.6	3 26 87	6.75
1307	...	"	56.6	5 59	3	7.15	7.4	4 27 84	7.15	3 20 87	7.25	3 7 88	7.1
1308	247	*Puppis*	59.1	19 23	2	6.6	6.7	3 22 84	6.6	4 19 87	6.6	.. .. ..	...
1309	162	*Monocerotis*	7 59.5	0 13	3	6.9	6.9	4 27 84	7.0	3 26 87	6.85	4 17 87	6.9
1310	163	"	8 0.4	8 53	3	6.4	6.5	4 27 84	6.35	3 20 87	6.4	3 7 88	6.4
1311	252	*Puppis*	1.8	20 12	3	5.75	5.9	3 22 84	5.8	3 7 86	5.7	4 2 88	5.8
1312	253	"	2.2	23 57	3	3.05	3.2	3 22 84	3.1	4 19 87	3.0	4 2 88	3.0
1313	164	*Monocerotis*	2.3	2 37	3	4.8	4.9	4 27 84	4.7	2 25 87	4.95	3 20 87	4.8
1314	165	"	3.0	10 59	4	6.6	6.6	4 27 84	6.65	3 26 87	6.6	3 23 89	6.45
1315	254	*Puppis*	8 3.0	23 15	4	6.9	6.7	3 22 84	6.8	4 19 87	6.9	4 2 88	6.95

No.	U. A. No.	Name	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
1316	255	*Puppis*	8 3.2	−20 0	3	6.9	7.0	3 22 84	6.8	4 19 87	7.0	4 24 87	6.9
1317	256	"	3.5	18 53	4	4.95	5.1	3 22 84	4.9	3 7 86	5.05	4 2 88	4.85
1318	257	"	3.8	15 53	3	6.0	6.0	3 25 84	6.1	3 25 87	5.95	4 19 87	6.0
1319	259	"	4.1	29 57	2	7.0	7.0	3 25 84	7.0	4 19 87	7.0	.. .. ..	...
1320	261	"	4.8	22 10	4	7.0	7.0	3 22 84	6.9	4 19 87	7.0	4 2 88	7.15
1321	262	"	4.9	13 26	3	6.0	6.0	3 25 84	5.9	3 25 87	6.1	4 19 87	6.0
1322	263	"	5.4	12 33	2	5.2	5.2	3 25 84	5.2	3 25 87	5.2	.. .. ..	...
1323	1	*Hydræ*	5.5	7 24	4	5.85	5.7	4 27 84	6.0	3 20 87	5.75	3 25 87	5.85
1324	3	"	7.0	0 48	3	6.9	6.7	4 27 84	7.0	3 25 87	6.85	3 26 87	6.9
1325	269	*Puppis*	7.6	15 25	3	5.65	5.7	3 25 84	5.7	3 25 87	5.6	4 2 88	5.7
1326	270	"	7.7	29 32	2	7.0	6.9	3 25 84	7.0	4 19 87	7.0	.. .. ..	...
1327	...	*Hydræ*	10.2	2 51	3	7.3	7.2	4 27 84	7.35	3 25 87	7.2	4 19 89	7.4
1328	...	"	10.8	8 38	4	6.65	6.9	4 27 84	6.8	3 25 87	6.7	3 24 89	6.55
1329	5	"	10.9	2 59	4	6.85	6.9	4 27 84	7.0	3 25 87	6.8	4 20 87	6.75
1330	281	*Puppis*	10.9	30 33	3	6.8	6.9	3 25 84	6.75	4 19 87	6.8	4 2 88	6.9
1331	283	"	11.4	20 56	2	6.9	6.9	3 22 84	6.9	3 25 87	6.9	.. .. ..	...
1332	284	"	11.7	15 54	6	6.65	6.8	3 25 84	6.8	3 25 87	6.7	4 2 88	6.7
1333	285	"	12.5	12 13	4	6.45	6.5	3 25 84	6.5	3 25 87	6.45	4 2 88	6.4
1334	286	"	12.9	29 37	2	7.0	7.0	3 25 84	7.0	4 19 87	7.0	.. .. ..	...
1335	7	*Hydræ*	13.3	9 47	4	6.6	6.7	4 27 84	6.65	3 25 87	6.7	3 24 89	6.4
1336	8	"	13.8	0 31	4	6.55	6.5	4 27 84	6.5	3 25 87	6.6	3 26 87	6.5
1337	...	*Puppis*	13.8	19 46	3	6.95	...	3 22 84	6.9	3 25 87	6.9	2 16 90	7.0
1338	9	*Hydræ*	14.1	4 56	5	6.65	6.5	4 27 84	6.5	3 25 87	6.6	4 2 88	6.75
1339	10	"	15.0	1 12	3	6.7	6.7	4 27 84	6.7	3 25 87	6.7	3 26 87	6.7
1340	291	*Puppis*	15.0	22 32	6	6.55	6.0	3 22 84	6.4	4 16 85	6.5	3 25 87	6.7
1341	11	*Hydræ*	15.7	10 39	3	6.9	6.8	4 27 84	6.9	3 25 87	6.9	3 24 89	6.9
1342	292	*Puppis*	15.8	19 41	4	6.0	6.0	3 22 84	6.0	4 16 85	6.1	3 25 87	6.0
1343	12	*Hydræ*	16.0	10 21	3	6.9	6.8	4 27 84	6.9	3 25 87	6.9	3 24 89	6.9
1344	293	*Puppis*	16.2	17 11	5	6.3	5.9	3 25 84	6.2	3 25 87	6.3	4 2 88	6.4
1345	13	*Hydræ*	16.4	5 47	4	6.4	6.4	4 27 84	6.35	3 25 87	6.45	4 2 88	6.55
1346	14	"	16.8	7 9	6	6.55	6.3	4 27 84	6.4	3 25 87	6.5	4 6 88	6.55
1347	296	*Puppis*	16.9	12 39	2	6.7	6.7	3 25 84	6.7	3 25 87	6.7	.. .. ..	...
1348	298	"	17.6	25 57	4	6.45	6.5	3 25 84	6.2	4 2 88	6.5	4 6 88	6.5
1349	15	*Hydræ*	18.4	3 21	2	6.15	6.2	4 27 84	6.15	4 20 87	6.15	.. .. ..	...
1350	16	"	18.4	4 19	5	6.35	6.7	4 27 84	6.25	3 25 87	6.4	4 20 87	6.3
1351	299	*Puppis*	18.7	28 34	2	7.0	6.8	3 25 84	7.0	4 19 87	7.0	.. .. ..	...
1352	...	"	18.8	15 3	4	7.0	...	3 25 84	7.0	3 25 87	7.0	4 2 88	7.0
1353	...	"	19.2	12 21	4	7.0	...	3 25 84	7.0	3 25 87	7.0	4 19 87	7.0
1354	19	*Hydræ*	19.4	3 30	4	3.75	3.8	4 27 84	3.6	4 20 87	3.8	4 27 87	3.8
1355	301	*Puppis*	19.5	22 45	4	5.95	5.9	3 22 84	5.8	3 25 87	6.0	4 19 87	6.0
1356	20	*Hydræ*	19.6	8 33	3	6.85	6.7	4 27 84	6.95	3 25 87	6.85	3 24 89	6.8
1357	302	*Puppis*	19.7	23 39	5	5.8	5.8	3 22 84	5.5	3 25 84	5.85	3 25 87	5.7
1358	303	"	19.8	20 39	4	6.4	6.5	3 22 84	6.4	4 16 85	6.4	3 25 87	6.3
1359	304	"	20.0	17 2	3	6.95	6.9	3 25 84	6.9	3 25 87	6.9	2 16 90	7.0
1360	21	*Hydræ*	20.0	8 7	4	6.95	6.9	4 27 84	7.0	3 25 87	6.85	4 20 87	7.05
1361	22	"	20.0	10 7	3	6.75	6.7	4 27 84	6.8	3 25 87	6.7	3 24 89	6.7
1362	305	*Puppis*	20.1	14 32	3	6.4	6.3	3 25 84	6.4	3 25 87	6.35	4 2 88	6.4
1363	23	*Hydræ*	20.2	3 35	2	6.15	6.2	4 27 84	6.15	4 20 87	6.15	.. .. ..	...
1364	308	*Puppis*	20.8	12 8	4	6.15	5.9	3 25 84	6.2	3 25 87	6.0	4 19 87	6.2
1365	24	*Hydræ*	21.1	6 0	4	6.75	6.8	4 27 84	6.8	3 25 87	6.6	4 20 87	6.8
1366	310	*Puppis*	21.6	14 32	3	6.95	6.9	3 25 84	6.9	3 25 87	7.0	4 2 88	7.0
1367	311	"	21.7	28 48	3	6.9	6.9	3 25 84	6.9	4 19 87	7.0	4 2 88	6.85
1368	313	"	8 22.0	20 26	3	6.6	6.7	3 22 84	6.7	4 16 85	6.5	3 25 87	6.6

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
1369	25	*Hydræ*	8 22.2	− 2 6	5	6.7	6.8	4 27 84	6.9	3 25 87	6.7	4 20 87	6.65
1370	26	"	22.3	8 24	3	6.75	6.7	4 27 84	6.8	3 25 87	6.7	3 24 89	6.8
1371	2	*Pyxidis*	22.6	25 43	3	6.9	6.9	3 25 84	6.95	4 16 85	6.9	4 17 87	6.9
1372	27	*Hydræ*	22.8	9 20	4	6.3	6.3	4 27 84	6.2	3 25 87	6.4	4 20 87	6.45
1373	28	"	23.1	0 33	2	7.0	7.0	4 27 84	7.0	3 25 87	7.0	.. .. ..	...
1374	3	*Pyxidis*	23.2	22 39	5	6.7	6.8	3 22 84	6.9	4 16 85	6.5	3 25 87	6.7
1375	5	"	23.3	20 32	3	6.8	6.9	3 22 84	6.9	3 25 87	6.7	4 19 87	6.85
1376	6	"	24.2	26 55	3	6.9	7.0	3 25 84	6.95	4 16 85	6.9	4 17 87	6.9
1377	9	"	25.9	19 9	3	5.45	5.6	3 25 84	5.4	3 7 86	5.55	4 19 87	5.45
1378	29	*Hydræ*	26.8	14 37	2	6.7	6.8	3 25 84	6.7	3 25 87	6.7	.. .. ..	...
1379	30	"	26.8	14 0	3	7.0	7.0	3 25 84	7.0	3 25 87	6.95	4 2 88	7.0
1380	31	"	27.0	4 48	4	6.9	7.0	4 27 84	6.8	4 20 87	7.0	5 9 87	7.0
1381	..	"	27.8	15 41	4	6.9	...	3 25 87	6.9	4 20 87	6.9	5 12 87	6.9
1382	33	"	27.7	1 44	3	6.25	6.4	4 27 84	6.25	3 25 87	6.25	4 2 88	6.3
1383	10	*Pyxidis*	27.7	24 11	7	6.6	6.4	3 25 84	6.8	4 16 85	6.6	4 19 87	6.8
1384	13	"	29.2	26 40	3	7.0	7.0	3 25 84	6.95	4 17 87	7.0	4 19 89	7.0
1385	35	*Hydræ*	29.4	7 33	2	6.1	6.1	4 27 84	6.1	3 25 87	6.1	.. .. ..	...
1386	15	*Pyxidis*	30.2	26 25	5	6.4	6.5	3 25 84	6.5	4 16 85	6.3	4 17 87	6.5
1387	37	*Hydræ*	31.2	4 30	3	6.75	6.9	4 27 84	6.7	4 20 87	6.75	4 2 88	6.75
1388	..	*Pyxidis*	31.7	25 59	4	7.35	7.3	3 25 84	7.3	4 17 87	7.4	5 7 88	7.45
1389	40	*Hydræ*	31.7	12 9	4	6.85	7.0	3 25 84	6.9	4 14 84	6.8	4 16 85	6.9
1390	38	"	31.8	6 22	3	6.85	6.8	4 27 84	6.8	4 20 87	6.9	4 3 88	6.9
1391	41	"	32.1	11 18	4	6.8	6.7	3 25 84	6.8	4 14 84	6.8	4 16 85	6.8
1392	39	"	32.2	6 14	3	6.85	6.8	4 27 84	6.8	4 20 87	6.9	4 3 88	6.9
1393	16	*Pyxidis*	32.5	25 49	8	5.6	5.6	3 25 84	5.7	3 7 86	5.5	4 17 87	5.55
1394	18	"	33.0	19 18	4	6.8	6.9	3 25 84	6.9	4 19 87	6.8	4 3 88	6.8
1395	43	*Hydræ*	33.3	12 18	4	6.9	6.9	3 25 84	6.9	4 14 84	6.8	4 16 85	6.9
1396	19	*Pyxidis*	33.7	22 14	5	5.4	5.6	3 25 84	5.2	4 19 87	5.45	4 24 87	5.5
1397	44	*Hydræ*	34.1	12 2	5	5.6	5.4	4 14 84	5.5	4 6 85	5.5	3 25 87	5.7
1398	45	"	34.2	16 51	5	6.85	6.7	3 25 84	6.9	4 14 84	6.8	4 16 85	6.9
1399	20	*Pyxidis*	34.5	29 7	4	5.55	5.4	3 25 84	5.4	3 7 86	5.6	4 17 87	5.6
1400	46	*Hydræ*	35.0	8 37	4	6.8	6.8	3 25 84	6.7	4 27 84	6.9	4 16 85	6.7
1401	47	"	35.9	15 30	3	5.25	5.3	4 14 84	5.2	4 6 85	5.2	3 25 87	5.3
1402	48	"	36.2	11 31	3	6.8	6.8	4 14 84	6.8	3 26 87	6.75	4 3 88	6.8
1403	51	"	37.5	6 47	4	4.95	4.9	4 14 84	4.8	4 27 84	5.15	3 25 87	4.85
1404	55	"	39.0	2 9	2	6.7	6.8	4 27 84	6.7	3 25 87	6.7	.. .. ..	...
1405	25	*Pyxidis*	39.3	20 43	5	6.55	6.6	3 25 84	6.55	4 19 87	6.5	4 6 88	6.6
1406	56	*Hydræ*	39.7	1 36	6	6.4	6.3	4 27 84	6.2	3 25 87	6.4	5 9 87	6.4
1407	58	"	40.1	10 33	3	6.8	6.7	4 14 84	6.8	3 26 87	6.75	4 3 88	6.9
1408	28	*Pyxidis*	40.4	24 56	2	6.5	6.5	3 25 84	6.5	4 19 87	6.5	.. .. ..	...
1409	60	*Hydræ*	40.5	13 6	4	4.55	4.4	4 14 84	4.4	3 25 87	4.4	5 7 88	4.65
1410	61	"	40.9	1 26	4	5.65	5.6	4 27 84	5.8	3 25 87	5.85	.. .. ..	...
1411	62	"	41.1	18 18	4	6.85	7.0	3 25 84	7.0	3 26 87	6.8	4 20 87	6.85
1412	63	"	41.6	16 36	3	6.75	6.7	4 14 84	6.8	3 26 87	6.7	4 3 88	6.8
1413	65	"	41.9	6 6	4	6.75	6.7	3 25 84	6.7	4 27 84	6.65	3 26 87	6.8
1414	66	"	42.3	0 35	6	6.8	6.7	3 25 84	6.5	4 27 84	6.8	3 25 87	6.9
1415	31	*Pyxidis*	43.0	28 11	2	7.0	7.0	3 25 84	7.0	4 17 87	7.0	.. .. ..	...
1416	67	*Hydræ*	43.1	2 59	3	5.5	5.7	4 27 84	5.6	3 25 87	5.5	4 3 88	5.4
1417	69	"	43.6	8 10	2	6.8	6.8	4 27 84	6.8	4 20 87	6.8	.. .. ..	...
1418	32	*Pyxidis*	44.1	20 35	5	6.8	6.9	3 25 84	6.8	4 19 87	6.8	4 6 88	6.8
1419	34	"	44.8	29 0	3	6.5	6.5	3 25 84	6.5	4 17 87	6.6	4 3 88	6.45
1420	35	"	45.1	28 9	3	6.5	6.4	3 25 84	6.5	4 17 87	6.6	4 3 88	6.45
1421	36	"	8 45.2	27 15	4	4.4	4.4	3 25 84	4.3	3 7 86	4.5	4 17 87	4.4

No.	U. A No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
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1422	70	*Hydræ*	8 45.4	− 6 43	4	5.85	6.0	4 27 84	5.9	3 25 87	5.8	4 6 88	5.8
1423	72	"	46.4	12 20	4	6.95	6.9	4 14 84	6.8	4 20 87	7.05	5 9 87	7.1
1424	73	"	46.6	12 46	3	6.65	6.6	4 14 84	6.7	3 26 87	6.6	4 28 89	6.7
1425	74	"	47.3	16 29	4	6.8	6.7	4 14 84	6.8	3 26 87	6.7	4 3 88	6.8
1426	75	"	48.2	4 58	3	6.5	6.4	4 27 84	6.4	4 20 87	6.5	4 28 89	6.55
1427	76	"	48.6	10 54	3	6.9	6.8	4 14 84	6.8	3 26 87	7.0	4 20 87	6.9
1428	78	"	49.3	10 54	3	6.8	6.8	4 14 84	6.8	3 26 87	6.75	4 3 88	6.85
1429	79	"	49.4	7 30	4	6.45	6.5	4 27 84	6.5	4 20 87	6.35	5 9 87	6.5
1430	80	"	49.5	17 46	5	6.1	6.0	4 14 84	6.0	3 26 87	6.2	4 20 87	6.3
1431	82	"	50.1	14 58	6	6.95	6.8	4 14 84	7.0	4 22 84	6.8	4 6 85	6.8
1432	40	*Pyxidis*	50.2	27 12	4	5.15	5.4	3 25 84	5.1	3 7 86	5.15	4 17 87	5.15
1433	41	"	50.4	23 21	3	6.8	6.7	4 6 88	6.8	4 8 88	6.8	4 19 89	6.75
1434	84	*Hydræ*	50.8	16 14	4	6.6	6.6	4 14 84	6.6	3 26 87	6.6	4 3 88	6.65
1435	85	"	51.1	16 57	4	6.75	6.8	4 14 84	6.7	4 20 87	6.7	4 3 88	6.8
1436	87	"	51.7	4 23	3	6.85	6.9	4 27 84	6.8	4 20 87	6.9	4 3 88	6.85
1437	88	"	52.9	15 40	4	6.3	6.4	4 14 84	6.4	3 26 87	6.3	4 3 88	6.2
1438	. . .	"	53.1	15 30	8	7.05	7.3	4 14 84	6.8	4 22 84	7.0	4 6 85	7.0
1439	89	"	54.0	18 43	2	6.6	6.6	4 14 84	6.6	3 26 87	6.6	. . . . . .	. . .
1440	42	*Pyxidis*	54.0	28 19	2	6.8	6.8	3 25 84	6.8	4 17 87	6.8	. . . . . .	. . .
1441	43	"	54.3	22 13	4	7.0	7.0	4 3 88	7.05	4 6 88	7.0	4 8 88	7.0
1442	. . .	*Hydræ*	54.7	8 42	4	7.05	7.1	4 27 84	6.9	4 20 87	7.0	4 3 88	7.0
1443	. . .	"	55.0	8 44	4	7.1	7.1	4 27 84	7.0	4 20 87	7.1	4 3 88	7.1
1444	44	*Pyxidis*	55.0	20 44	3	7.05	7.0	4 6 88	7.0	4 8 88	7.05	4 19 89	7.05
1445	45	"	55.4	23 40	3	7.0	7.0	4 6 88	7.0	4 8 88	7.0	4 19 89	7.0
1446	92	*Hydræ*	55.6	0 0	3	6.05	6.2	4 27 84	6.0	4 20 87	6.1	4 3 88	6.0
1447	46	*Pyxidis*	55.8	26 10	3	6.75	6.8	3 25 84	6.8	4 19 87	6.75	4 3 88	6.75
1448	. . .	"	56.4	26 5	4	7.15	7.3	3 25 84	7.1	3 6 85	7.2	4 19 87	7.2
1449	91	*Hydræ*	57.3	3 58	7	7.1	6.8	4 27 84	6.8	4 20 87	7.0	5 9 87	7.2
1450	93	"	57.5	4 41	3	6.95	6.7	4 27 84	6.9	4 20 87	6.9	4 28 89	7.0
1451	47	*Pyxidis*	57.7	25 1	4	6.9	6.9	3 25 84	6.8	4 19 87	6.9	4 3 88	6.9
1452	94	*Hydræ*	8 58.0	17 0	4	6.95	7.0	4 14 84	6.9	3 26 87	6.95	4 3 88	7.0
1453	98	"	9 1.1	17 42	3	6.9	6.9	4 14 84	6.9	3 26 87	6.95	4 28 89	6.85
1454	99	"	2.6	8 5	4	5.8	5.8	4 13 84	5.7	4 17 85	5.9	4 20 87	5.8
1455	50	*Pyxidis*	2.6	25 21	9	4.9	4.9	3 25 84	4.8	3 7 86	5.0	4 26 86	4.8
1456	100	*Hydræ*	2.9	15 46	2	6.9	6.8	4 14 84	6.9	3 26 87	6.9	. . . . . .	. . .
1457	101	"	3.2	11 51	3	6.25	6.2	4 13 84	6.2	4 14 84	6.3	3 26 87	6.2
1458	51	*Pyxidis*	3.2	25 20	3	7.1	6.9	3 25 84	7.3	3 6 85	7.1	4 19 87	7.0
1459	52	"	3.3	26 16	6	6.5	6.5	3 25 84	6.5	4 26 86	6.5	4 29 86	6.5
1460	102	*Hydræ*	3.3	17 49	5	6.15	6.2	4 14 84	6.3	3 26 87	6.2	4 3 88	6.0
1461	103	"	3.5	8 17	4	5.85	5.7	4 13 84	5.9	4 14 84	5.9	4 17 85	5.8
1462	. . .	"	4.3	16 21	2	7.1	7.1	4 14 84	7.1	3 26 87	7.1	. . . . . .	. . .
1463	53	*Pyxidis*	4.3	29 19	3	6.85	7.0	3 25 84	6.8	4 17 87	6.8	4 3 88	7.0
1464	54	"	4.3	25 18	3	7.0	7.0	3 25 84	7.0	4 19 87	7.0	4 3 88	7.0
1465	55	"	4.7	29 51	3	6.1	6.0	3 25 84	6.15	4 17 87	6.1	4 28 89	6.0
1466	56	"	4.8	22 40	3	6.7	6.7	4 3 88	6.65	4 6 88	6.7	4 8 88	6.8
1467	106	*Hydræ*	6.3	6 36	3	6.35	6.3	4 13 84	6.4	4 17 85	6.3	4 3 88	6.3
1468	107	"	6.3	19 14	2	6.4	6.4	4 14 84	6.4	3 26 87	6.4	. . . . . .	. . .
1469	57	*Pyxidis*	7.0	28 26	3	6.85	6.8	3 25 84	7.0	4 17 87	6.8	4 19 87	6.8
1470	58	"	8.0	29 9	2	6.8	7.0	3 25 84	6.8	4 17 87	6.8	. . . . . .	. . .
1471	109	*Hydræ*	8.1	14 11	6	6.8	6.7	4 13 84	7.0	4 29 86	6.6	3 26 87	6.8
1472	110	"	8.5	1 4	3	6.75	6.7	4 14 84	6.7	4 17 85	6.8	4 3 88	6.8
1473	111	"	9.5	14 30	4	6.4	6.5	4 13 84	6.4	4 29 86	6.4	3 26 87	6.5
1474	112	"	9 10.5	5 50	3	5.8	5.6	4 13 84	5.7	4 17 85	5.9	4 20 87	5.8

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			h. m.	° ′									
1475	113	*Hydræ*	9 10.5	−13 19	4	6.95	6.8	4 13 84	7.0	4 29 86	6.9	3 26 87	6.85
1476	114	"	10.6	8 13	3	5.7	6.0	4 13 84	5.7	4 17 85	5.7	4 3 88	5.75
1477	117	"	10.9	10 35	3	6.65	6.8	4 13 84	6.7	4 17 85	6.6	4 3 88	6.7
1478	118	"	11.2	14 3	4	6.15	6.1	4 13 84	6.2	4 29 86	6.1	3 26 87	6.1
1479	...	"	13.1	16 17	3	6.7	6.9	4 13 84	6.7	3 26 87	6.6	4 3 88	6.85
1480	120	"	13.5	10 47	3	6.65	6.6	4 13 84	6.7	4 17 85	6.6	4 3 88	6.7
1481	121	"	13.7	15 18	4	6.0	6.0	4 13 84	5.9	4 29 86	6.0	3 26 87	6.05
1482	122	"	13.8	11 27	3	5.3	5.3	4 13 84	5.3	4 17 85	5.3	3 6 86	5.25
1483	124	"	14.4	9 2	2	5.2	5.2	4 13 84	5.2	4 17 85	5.2	.. .. ..	...
1484	126	"	15.0	15 5	4	6.65	6.7	4 13 84	6.7	4 29 86	6.6	3 26 87	6.55
1485	127	"	15.4	2 16	4	6.8	6.8	4 14 84	6.7	4 17 85	6.8	4 3 88	6.9
1486	61	*Pyxidis*	16.0	25 26	5	5.5	5.2	3 25 84	5.5	3 7 86	5.5	4 26 86	5.45
1487	128	*Hydræ*	16.6	14 42	4	6.85	6.9	4 13 84	6.7	4 29 86	6.9	3 26 87	6.9
1488	129	"	16.8	9 18	3	6.75	6.7	4 13 84	6.7	4 17 85	6.8	4 3 88	6.7
1489	62	*Pyxidis*	17.8	28 18	5	5.25	5.3	3 25 84	5.3	3 7 86	5.15	4 26 86	5.2
1490	133	*Hydræ*	18.6	3 45	6	6.95	7.0	4 14 84	6.7	4 17 85	7.1	4 20 87	7.0
1491	134	"	19.2	4 35	3	6.2	6.0	4 14 84	6.2	4 6 85	6.2	4 17 85	6.2
1492	...	"	19.2	5 52	4	7.0	...	4 17 85	7.0	4 20 87	7.0	4 6 88	6.95
1493	135	"	19.7	0 42	4	6.8	7.0	4 14 84	6.7	4 17 85	6.8	4 3 88	6.9
1494	136	"	20.0	0 56	4	6.5	6.4	4 14 84	6.5	4 6 85	6.5	4 17 85	6.5
1495	65	*Pyxidis*	20.1	24 48	2	6.9	6.9	4 26 86	6.9	4 29 86	6.9	.. .. ..	...
1496	138	*Hydræ*	21.0	18 37	4	7.0	7.0	3 25 84	7.0	4 26 86	6.9	3 26 87	7.0
1497	...	*Pyxidis*	21.0	23 38	2	6.9	6.9	3 26 87	6.9	4 13 88	6.9	.. .. ..	...
1498	139	*Hydræ*	21.1	8 41	3	6.85	6.7	4 13 84	6.8	4 13 87	6.9	4 3 88	6.8
1499	66	*Pyxidis*	21.3	28 15	6	6.5	6.5	4 26 86	6.5	4 29 86	6.5	4 13 87	6.5
1500	140	*Hydræ*	21.5	8 7	3	2.05	2.1	4 29 86	2.0	4 8 88	2.1	4 28 89	2.0
1501	141	*Hydræ*	21.6	21 48	4	5.4	5.1	3 25 84	5.4	4 26 86	5.3	3 26 87	5.4
1502	142	"	21.6	5 32	3	5.7	5.7	4 14 84	5.8	4 28 84	5.7	4 17 85	5.6
1503	3	*Leonis*	21.8	+ 8 44	4	6.15	6.3	6 5 86	5.9	5 12 87	6.2	5 14 87	6.2
1504	...	*Hydræ*	22.0	− 9 29	3	7.35	7.5	4 13 84	7.3	4 13 87	7.35	3 30 89	7.4
1505	143	"	22.2	9 27	2	7.0	6.9	4 13 84	7.0	4 13 87	7.0	.. .. ..	...
1506	144	"	22.7	0 43	3	6.6	6.5	4 14 84	6.6	4 17 85	6.6	4 3 88	6.6
1507	145	"	22.8	2 13	5	4.7	4.8	4 14 84	4.6	4 17 85	4.7	3 6 86	4.9
1508	146	"	23.1	1 40	4	6.35	6.6	4 14 84	6.3	4 6 85	6.3	4 17 85	6.4
1509	147	"	23.3	3 42	4	6.6	6.7	4 14 84	6.7	4 17 85	6.5	4 20 87	6.55
1510	148	"	23.5	20 12	5	6.3	6.4	3 25 84	6.4	4 26 86	6.3	3 26 87	6.25
1511	149	"	24.2	22 48	3	6.95	6.8	3 25 84	7.0	4 26 86	6.9	3 26 87	6.9
1512	3	*Antliæ*	24.4	26 3	5	5.9	6.0	3 25 84	5.9	3 7 86	5.9	4 26 86	5.9
1513	5	"	24.5	27 42	12	7.4	7.0	3 25 84	7.3	4 26 86	7.1	4 29 86	7.1
1514	...	"	24.6	23 44	2	7.0	...	3 26 87	7.0	4 13 88	7.0	.. .. ..	...
1515	150	*Hydræ*	24.5	15 2	5	6.25	6.3	4 14 84	6.4	4 13 87	6.2	5 9 87	6.2
1516	...	"	24.7	5 7	4	7.0	...	4 17 85	7.1	4 20 87	7.0	5 9 87	7.0
1517	7	*Antliæ*	25.2	28 13	4	7.0	7.0	3 25 84	7.0	4 26 86	7.0	4 29 86	7.0
1518	152	*Hydræ*	25.6	0 38	5	4.85	4.8	4 14 84	4.9	4 17 85	4.9	3 6 86	4.8
1519	153	"	25.6	10 0	2	6.5	6.5	4 13 84	6.5	4 13 87	6.5	.. .. ..	...
1520	154	"	25.9	9 49	3	6.55	6.4	4 13 84	6.5	4 13 87	6.55	3 30 89	6.55
1521	156	"	26.5	18 51	4	6.1	6.1	3 25 84	6.0	2 26 86	6.1	3 26 87	6.1
1522	12	*Antliæ*	26.8	28 5	4	var.	6.9	3 25 84	6.8	4 26 86	6.8	4 29 86	6.8
1523	157	*Hydræ*	26.9	7 57	3	6.65	6.5	4 13 84	6.7	4 6 85	6.7	4 17 85	6.6
1524	158	"	26.9	12 58	4	6.6	6.6	4 14 84	6.5	4 13 87	6.6	4 20 87	6.65
1525	159	"	27.2	6 38	5	6.65	6.6	4 14 84	6.7	4 17 85	6.5	4 17 87	6.7
1526	160	"	27.5	20 34	3	5.7	5.6	3 25 84	5.8	4 26 86	5.6	3 26 87	5.7
1527	161	"	9 27.6	20 50	4	6.95	7.0	3 25 84	7.0	4 26 86	6.9	3 26 87	7.0

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1528	162	*Hydræ*	9 27.8	−22 19	3	6.3	6.3	3 25 84	6.3	4 26 86	6.4	3 26 87	6.25
1529	163	"	28.3	5 21	4	6.0	6.0	4 14 84	6.0	4 28 84	6.0	4 17 85	5.9
1530	164	"	28.8	11 34	3	6.75	6.8	4 14 84	6.7	4 13 87	6.75	4 6 88	6.75
1531	165	"	29.8	19 1	4	6.55	6.6	3 25 84	6.5	4 26 86	6.6	3 26 87	6.45
1532	15	*Antliæ*	30.9	24 9	5	6.8	6.8	3 25 84	6.8	4 26 86	6.8	4 29 86	6.8
1533	16	"	31.4	24 44	6	6.3	6.4	3 25 84	6.15	4 26 86	6.4	4 29 86	6.4
1534	166	*Hydræ*	31.5	2 37	4	6.8	6.8	4 14 84	6.7	4 17 85	6.8	4 6 88	6.9
1535	167	"	31.7	8 52	2	6.7	6.7	4 13 84	6.7	4 6 85	6.7	.. .. ..	...
1536	169	"	33.1	17 4	2	6.8	6.7	4 14 84	6.8	4 26 86	6.8	.. .. ..	...
1537	170	"	33.5	0 35	6	4.2	3.9	4 14 84	3.9	4 17 85	4.2	3 6 86	4.2
1538	171	"	33.7	10 0	3	6.5	6.5	4 13 84	6.5	4 13 87	6.55	3 30 89	6.45
1539	172	"	34.2	10 12	3	6.5	6.7	4 13 84	6.5	4 13 84	6.5	3 30 89	6.5
1540	173	"	34.3	13 46	4	5.4	5.4	4 14 84	5.3	4 22 86	5.4	3 6 86	5.4
1541	174	"	35.6	23 1	4	5.05	5.2	3 25 84	5.0	4 26 87	5.1	3 26 87	5.1
1542	21	*Antliæ*	36.4	29 44	3	7.0	7.0	3 25 84	7.0	4 13 86	6.95	4 6 88	7.05
1543	175	*Hydræ*	36.6	23 22	4	5.3	5.4	3 25 84	5.2	4 26 86	5.3	3 26 87	5.4
1544	176	"	37.7	19 48	3	6.95	7.0	3 25 84	7.0	4 26 87	6.9	4 6 88	6.95
1545	23	*Antliæ*	38.6	27 12	5	5.05	5.1	3 25 84	5.0	4 13 84	5.0	3 7 86	5.0
1546	25	"	39.9	29 38	3	6.7	6.7	3 25 84	6.7	4 13 87	6.7	4 6 88	6.7
1547	2	*Sextantis*	41.0	9 57	3	7.0	6.9	4 28 84	6.9	4 13 87	7.05	4 24 87	7.0
1548	3	"	41.1	10 10	2	6.9	7.0	4 28 84	6.9	4 13 87	6.9	.. .. ..	...
1549	4	"	42.0	6 40	4	6.9	6.8	4 28 84	7.0	4 13 87	6.9	4 8 88	6.75
1550	5	"	42.6	9 20	4	6.9	6.8	4 28 84	7.0	4 13 87	6.9	4 8 88	6.85
1551	6	"	43.1	8 15	4	7.0	7.0	4 28 84	7.0	4 13 87	7.05	4 24 87	7.0
1552	30	*Antliæ*	43.1	25 50	8	6.95	6.9	3 25 84	7.0	4 13 84	7.1	4 13 87	6.95
1553	177	*Hydræ*	43.5	11 12	4	6.9	7.0	4 28 84	6.8	4 13 87	6.9	4 6 88	7.0
1554	8	*Sextantis*	44.9	3 40	2	6.2	6.2	4 28 84	6.2	4 13 87	6.2	.. .. ..	...
1555	9	"	45.1	5 36	3	6.65	6.6	4 28 84	6.65	4 13 87	6.6	3 30 89	6.75
1556	178	*Hydræ*	45.5	14 16	6	4.2	4.0	4 14 84	4.2	4 22 84	3.9	3 6 86	4.2
1557	10	*Sextantis*	45.6	10 45	3	6.8	6.8	4 28 84	6.8	4 13 87	6.9	4 8 88	6.75
1558	179	*Hydræ*	46.0	15 57	2	6.7	6.6	4 13 84	6.7	4 6 85	6.7	.. .. ..	...
1559	13	*Sextantis*	46.3	7 31	4	5.3	5.4	4 22 84	5.2	4 28 84	5.3	4 22 86	5.3
1560	15	"	47.2	9 19	3	7.0	7.0	4 28 84	7.0	4 13 87	6.9	4 8 88	7.05
1561	33	*Antliæ*	47.4	26 45	7	6.6	6.6	4 13 84	6.4	4 13 87	6.6	4 19 87	6.65
1562	34	"	48.5	27 25	8	6.85	7.0	3 25 84	6.4	4 13 84	7.1	4 13 87	6.7
1563	180	*Hydræ*	48.5	12 21	3	6.8	6.7	4 28 84	6.8	4 20 87	6.75	4 6 88	6.8
1564	181	"	48.6	25 21	3	5.35	5.3	3 25 84	5.3	4 13 84	5.4	4 6 88	5.35
1565	182	"	48.7	21 54	5	6.5	6.3	3 25 84	6.7	4 13 84	6.4	4 26 86	6.4
1566	183	"	49.0	18 25	3	5.6	5.6	4 13 84	5.7	4 26 86	5.5	4 20 87	5.6
1567	184	"	49.0	15 36	5	7.0	6.9	4 13 84	7.1	4 20 87	6.95	5 9 87	7.05
1568	17	*Sextantis*	49.6	8 15	3	6.7	6.8	4 28 84	6.65	4 13 87	6.75	4 8 88	6.75
1569	18	"	49.9	7 3	2	6.9	6.9	4 28 84	6.9	4 13 87	6.9	.. .. ..	...
1570	185	*Hydræ*	51.1	25 57	8	6.55	6.6	3 25 84	6.7	4 13 84	6.4	4 13 87	6.6
1571	37	*Antliæ*	51.3	26 53	9	6.55	6.7	3 25 84	6.4	4 13 84	6.4	4 6 85	6.4
1572	20	*Sextantis*	51.4	1 21	5	6.55	6.7	4 28 84	6.65	4 21 87	6.6	4 8 88	6.55
1573	186	*Hydræ*	51.7	15 56	3	6.95	7.0	4 13 84	6.9	4 6 85	6.9	4 28 89	7.0
1574	187	"	52.5	24 32	5	6.95	6.9	3 25 84	7.0	4 13 84	7.0	4 26 86	6.9
1575	188	"	53.3	23 21	7	6.35	6.2	3 25 84	6.4	4 13 84	6.3	4 6 85	6.4
1576	189	"	53.4	19 46	3	6.9	6.8	4 13 84	6.9	4 14 87	6.95	4 28 89	6.9
1577	22	*Sextantis*	56.4	0 28	3	6.9	6.9	4 28 84	7.0	4 21 87	6.8	4 24 87	6.95
1578	190	*Hydræ*	56.7	19 49	4	6.9	6.7	4 13 84	6.8	4 14 87	6.9	4 6 88	6.95
1579	39	*Antliæ*	57.2	29 59	3	6.9	6.8	4 13 87	6.9	4 19 87	6.9	4 20 87	6.9
1580	23	*Sextantis*	9 57.5	8 58	9	6.65	6.4	4 28 84	6.4	4 21 87	6.8	4 24 87	6.5

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1581	191	*Hydræ*	9 57.9	−24 43	5	6.8	6.8	3 25 84	7.0	4 13 84	6.7	4 26 86	6.75
1582	192	"	58.1	17 30	3	6.1	6.3	4 13 84	6.1	4 13 87	6.1	4 8 88	6.15
1583	193	"	58.6	23 41	8	6.0	6.1	3 25 84	5.9	4 13 84	5.9	4 6 85	5.9
1584	...	*Antliæ*	58.6	27 46	3	7.35	7.5	3 25 84	7.35	4 13 87	7.3	4 6 88	7.35
1585	194	*Hydræ*	59.0	12 28	34	4.7	4.6	4 22 84	4.7	3 6 86	4.65	4 6 88	4.85
1586	41	*Antliæ*	59.2	27 35	3	7.0	6.9	3 25 84	7.0	4 13 87	6.95	4 6 88	7.0
1587	42	"	9 59.5	27 35	3	7.0	6.9	3 25 84	7.0	4 13 87	6.95	4 6 88	7.0
1588	...	*Hydræ*	10 0.9	16 50	3	6.75	...	4 13 84	6.8	4 13 87	6.7	4 8 88	6.7
1589	195	"	1.2	16 32	4	6.25	6.0	4 13 84	6.1	4 13 87	6.25	5 9 87	6.3
1590	196	"	1.2	20 39	2	6.8	6.9	4 13 84	6.8	4 14 87	6.8	.. .. ..	...
1591	...	*Sextantis*	1.2	7 7	4	7.3	7.4	4 28 84	7.2	4 21 87	7.2	3 23 90	7.4
1592	26	"	1.5	7 1	3	6.95	6.8	4 28 84	7.0	4 21 87	6.95	4 28 89	6.9
1593	27	"	1.6	+ 0 14	4	4.5	4.9	4 17 85	4.5	3 6 86	4.6	4 21 87	4.4
1594	29	"	2.6	−10 16	3	6.65	6.6	4 22 84	6.6	4 6 85	6.7	4 21 87	6.7
1595	197	*Hydræ*	2.6	15 0	2	6.6	6.7	4 13 84	6.6	4 6 85	6.6	.. .. ..	...
1596	...	"	3.1	14 52	2	7.4	7.5	4 13 84	7.4	4 20 87	7.4	.. .. ..	...
1597	198	"	3.3	17 31	4	6.9	6.9	4 13 84	7.0	4 13 87	6.9	4 8 88	6.85
1598	199	"	3.8	11 29	3	6.65	6.9	4 22 84	6.6	4 6 85	6.7	5 9 87	6.6
1599	31	*Sextantis*	3.9	7 48	7	6.05	6.2	4 28 84	6.1	4 22 86	6.3	4 21 87	5.9
1600	200	*Hydræ*	4.0	12 12	2	6.0	5.9	4 22 84	6.0	4 20 87	6.0	.. .. ..	...
1601	201	"	4.5	11 44	4	3.4	3.4	4 14 84	3.4	4 22 84	3.4	3 6 86	3.4
1602	202	"	4.6	17 59	4	6.9	6.9	4 13 84	7.0	4 13 87	6.9	4 8 88	6.85
1603	32	*Sextantis*	4.7	7 48	2	6.0	5.9	4 28 84	6.0	4 22 86	6.0	.. .. ..	...
1604	33	"	5.1	6 42	2	6.4	6.3	4 28 84	6.4	4 22 86	6.4	.. .. ..	...
1605	203	*Hydræ*	5.4	18 20	3	6.9	6.9	4 13 84	6.9	4 13 87	6.9	4 8 88	6.85
1606	53	*Antliæ*	6.4	27 59	2	6.4	6.4	3 25 84	6.4	4 13 87	6.4	.. .. ..	...
1607	204	*Hydræ*	6.7	18 32	3	6.7	6.7	4 13 84	6.7	4 13 87	6.7	4 8 88	6.75
1608	..	"	7.1	19 4	4	6.95	...	4 13 87	7.0	4 20 87	6.9	4 8 88	6.85
1609	205	"	7.6	26 25	2	6.4	6.4	3 25 84	6.4	4 13 87	6.4	.. .. ..	...
1610	206	"	8.3	23 12	5	6.8	6.8	4 16 85	6.6	4 26 86	6.85	4 14 87	6.9
1611	35	*Sextantis*	10.0	10 35	3	6.6	6.5	4 22 84	6.6	4 6 85	6.7	4 21 87	6.5
1612	207	*Hydræ*	10.6	18 41	3	6.75	6.7	4 13 84	6.8	4 13 87	6.7	4 8 88	6.75
1613	208	"	10.9	20 3	4	6.7	6.7	4 13 84	6.8	4 13 87	6.7	4 8 88	6.65
1614	36	*Sextantis*	11.4	7 27	4	5.6	5.6	4 28 84	5.55	4 22 86	5.7	4 21 87	5.75
1615	59	*Antliæ*	12.4	28 22	4	5.8	5.8	3 25 84	5.8	4 13 87	5.9	4 8 88	5.6
1616	209	*Hydræ*	13.1	11 54	4	6.35	6.4	4 22 84	6.3	4 20 87	6.35	4 8 88	6.45
1617	37	*Sextantis*	13.3	4 29	2	6.7	6.6	4 28 84	6.7	4 21 87	6.7	.. .. ..	...
1618	...	"	13.3	4 36	3	7.45	7.5	4 28 84	7.4	4 21 87	7.5	4 28 89	7.5
1619	38	"	13.8	8 26	4	6.45	6.6	4 28 84	6.55	4 22 86	6.4	4 21 87	6.4
1620	...	"	14.5	4 45	4	7.0	7.1	4 28 84	7.15	4 21 87	6.9	4 24 87	7.0
1621	40	"	14.8	4 47	4	6.95	6.9	4 28 84	7.05	4 21 87	6.9	4 24 87	6.9
1622	210	*Hydræ*	15.1	17 21	3	6.8	6.8	4 13 84	6.8	4 19 87	6.8	4 8 88	6.85
1623	211	"	15.1	13 10	4	6.7	6.7	4 22 84	6.7	4 16 85	6.7	4 20 87	6.7
1624	212	"	15.5	24 45	5	6.9	7.0	4 16 85	7.0	4 26 86	6.85	4 14 87	6.8
1625	213	"	15.6	23 5	5	6.55	6.6	4 16 85	6.6	4 26 86	6.6	4 14 87	6.5
1626	214	"	15.7	21 54	5	6.6	6.5	4 16 85	6.6	4 26 86	6.6	4 14 87	6.6
1627	215	"	16.0	17 24	4	7.0	7.0	4 13 84	6.9	4 19 87	7.0	4 8 88	7.05
1628	216	"	16.1	12 47	3	6.9	6.8	4 22 84	6.9	4 20 87	6.85	4 8 88	6.9
1629	217	"	16.2	19 14	3	6.45	6.5	4 13 84	6.4	4 13 87	6.45	4 8 88	6.45
1630	218	"	17.1	23 42	4	6.85	6.8	4 16 85	6.9	4 14 87	6.8	4 20 87	6.8
1631	42	*Sextantis*	17.1	0 16	4	6.8	6.7	4 28 84	6.7	4 21 87	6.9	4 24 87	6.7
1632	43	"	17.1	3 27	4	6.15	6.2	4 28 84	6.2	4 21 87	6.1	4 24 87	6.05
1633	44	"	10 17.2	3 1	3	6.95	6.8	4 28 84	6.9	4 21 87	6.9	4 9 88	7.0

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1634	219	*Hydræ*	10 17.2	−12 45	4	6.8	6.7	4 22 84	6.9	4 20 87	6.7	5 9 87	6.9
1635	63	*Antliæ*	17.5	29 32	5	6.55	6.6	3 25 84	6.3	4 13 87	6.6	4 19 87	6.5
1636	47	*Sextantis*	19.5	6 26	4	6.1	6.0	4 28 84	6.2	4 21 87	6.05	4 24 87	6.1
1637	220	*Hydræ*	19.6	28 34	5	7.1	6.9	3 25 84	7.1	4 13 87	6.9	5 12 87	7.1
1638	50	*Sextantis*	20.0	5 48	5	6.9	6.9	4 28 84	6.7	4 21 87	6.9	4 24 87	6.95
1639	221	*Hydræ*	20.1	16 12	4	4.05	4.0	4 22 84	4.2	3 6 86	3.95	4 22 86	4.0
1640	51	*Sextantis*	20.2	0 21	4	6.8	6.8	4 28 84	6.9	4 21 87	6.8	4 9 88	6.7
1641	52	"	20.5	3 45	4	6.8	6.8	4 28 84	6.7	4 21 87	6.8	4 9 88	6.85
1642	222	*Hydræ*	21.4	17 39	3	6.95	7.0	4 13 84	6.9	4 19 87	7.0	4 8 88	6.95
1643	67	*Antliæ*	21.4	30 26	3	4.6	4.4	3 25 84	4.5	4 19 87	4.7	4 8 88	4.6
1644	53	*Sextantis*	22.4	3 6	3	6.4	6.3	4 28 84	6.4	4 21 87	6.4	4 9 88	6.35
1645	223	*Hydræ*	22.6	18 53	3	6.95	7.0	4 13 84	6.9	4 19 87	7.0	4 8 88	6.95
1646	54	*Sextantis*	23.1	2 6	5	5.45	5.5	4 28 84	5.35	4 17 85	5.4	3 6 86	5.5
1647	224	*Hydræ*	23.7	29 2	6	6.2	6.0	3 25 84	6.3	4 6 85	6.2	4 13 87	6.2
1648	68	*Antliæ*	23.8	29 58	5	5.7	6.0	3 25 84	5.9	4 6 85	5.8	4 13 87	5.75
1649	56	*Sextantis*	23.9	+ 0 0	3	5.2	5.2	4 28 84	5.1	4 17 85	5.3	3 6 86	5.2
1650	58	"	24.7	− 7 0	4	6.6	6.6	4 28 84	6.5	4 21 87	6.55	4 27 87	6.6
1651	225	*Hydræ*	24.9	12 57	8	5.8	5.9	4 22 84	5.6	4 22 86	5.9	4 17 87	5.5
1652	226	"	25.0	25 51	3	6.75	6.6	3 25 84	6.7	4 14 87	6.8	4 8 88	6.75
1653	227	"	26.0	27 36	5	6.4	6.4	3 25 84	6.3	4 6 85	6.5	4 14 87	6.6
1654	60	*Sextantis*	26.2	5 26	4	6.95	7.0	4 28 84	6.9	4 21 87	7.15	4 24 87	6.9
1655	228	*Hydræ*	27.0	21 53	3	6.9	6.8	4 16 85	6.9	4 26 86	6.85	4 8 88	6.9
1656	229	"	27.1	12 46	4	6.9	7.0	4 22 84	6.7	4 22 86	6.9	4 17 87	6.95
1657	230	"	28.1	23 6	3	5.75	5.6	4 16 85	5.8	4 26 86	5.7	4 8 88	5.7
1658	61	*Sextantis*	28.5	3 15	3	6.7	6.8	4 28 84	6.7	4 21 87	6.7	4 9 88	6.7
1659	231	*Hydræ*	29.0	22 32	4	6.4	6.5	4 16 85	6.3	4 26 86	6.6	4 14 87	6.3
1660	232	"	29.2	12 13	3	6.8	6.9	4 22 84	6.8	4 22 86	6.8	4 17 87	6.8
1661	233	"	29.6	17 55	3	6.65	6.7	4 22 84	6.65	4 19 87	6.65	4 8 88	6.7
1662	63	*Sextantis*	30.1	9 56	4	6.7	6.8	5 16 84	6.6	4 22 86	6.8	4 21 87	6.7
1663	234	*Hydræ*	30.2	15 42	2	6.65	6.6	4 22 84	6.65	4 19 87	6.65	.. .. ..	...
1664	235	"	30.2	26 2	7	6.5	6.6	3 25 84	6.3	4 6 85	6.5	4 14 87	6.6
1665	236	"	30.3	11 34	4	6.2	6.2	4 22 84	6.1	4 22 86	6.3	4 17 87	6.2
1666	237	"	30.8	28 8	3	6.95	7.0	3 25 84	6.9	4 14 87	7.0	4 8 88	6.9
1667	64	*Sextantis*	30.8	8 11	3	6.9	7.0	5 16 84	6.9	4 21 87	6.9	4 27 87	6.9
1668	238	*Hydræ*	30.9	27 1	4	6.95	7.0	3 25 84	6.9	4 14 87	6.9	4 8 88	7.05
1669	239	"	31.0	11 6	3	6.8	6.8	4 22 84	6.8	4 22 86	6.8	4 17 87	6.8
1670	240	"	31.4	12 44	..	var.	var.	4 22 84	5.9	4 22 86	6.1	4 17 87	5.9
1671	241	"	31.4	26 46	3	5.2	5.3	3 25 84	5.2	4 26 86	5.2	4 8 88	5.25
1672	242	"	32.5	16 14	4	5.2	5.3	4 22 84	5.15	4 22 86	5.2	4 9 88	5.25
1673	243	"	32.7	11 48	4	6.4	6.4	4 22 84	6.4	4 22 86	6.5	4 17 87	6.5
1674	65	*Sextantis*	35.1	1 5	3	6.65	6.5	5 16 84	6.6	4 21 87	6.7	4 9 88	6.6
1675	244	*Hydræ*	36.0	13 8	2	7.0	6.9	4 22 84	7.0	4 20 87	7.0	.. .. ..	...
1676	67	*Sextantis*	36.2	8 5	4	6.9	6.9	5 16 84	6.9	4 21 87	6.95	4 27 87	6.95
1677	245	*Hydræ*	36.4	13 19	4	6.8	6.8	4 22 84	6.95	4 20 87	6.9	4 9 88	6.7
1678	246	"	36.9	22 54	3	6.95	6.9	4 16 85	6.9	4 14 87	7.0	4 8 88	6.95
1679	248	"	38.5	23 20	3	6.9	7.0	4 16 85	6.9	4 14 87	6.9	4 8 88	6.9
1680	249	"	40.8	16 38	5	5.7	5.8	4 24 84	5.8	4 22 86	5.65	5 9 87	5.8
1681	250	"	40.8	25 24	3	6.95	6.9	4 16 85	7.0	4 14 87	6.9	4 8 88	6.95
1682	251	"	41.5	14 36	4	6.5	6.7	4 22 84	6.4	4 20 87	6.5	4 9 88	6.6
1683	...	"	41.5	14 85	3	7.8	7.3	4 22 84	7.4	4 20 87	7.25	4 9 88	7.25
1684	70	*Sextantis*	42.3	1 18	2	6.35	6.4	5 16 84	6.35	4 21 87	6.35	.. .. ..	...
1685	71	"	42.7	8 26	5	7.1	6.9	5 16 84	7.0	4 21 87	7.1	4 24 87	7.2
1686	72	"	10 43.0	3 22	3	6.65	6.7	5 16 84	6.6	4 21 87	6.7	4 9 88	6.6

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
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1687	253	*Hydræ*	10 43.0	−27 16	4	6.95	7.0	4 16 85	7.0	4 14 87	6.9	4 8 88	7.05
1688	254	"	43.5	15 33	5	3.1	3.0	4 22 84	2.9	4 26 84	3.2	3 6 86	2.9
1689	73	*Sextantis*	43.5	9 11	3	6.4	6.4	5 16 84	6.4	4 21 87	6.35	4 27 87	6.4
1690	74	"	44.0	8 14	5	6.05	6.0	5 16 84	6.2	4 21 87	6.1	4 27 87	6.1
1691	75	"	44.7	2 26	2	6.35	6.4	5 16 84	6.35	4 21 87	6.35	.. .. ..	...
1692	255	*Hydræ*	45.0	17 40	3	6.85	6.8	4 22 84	6.9	4 20 87	6.8	4 9 88	6.85
1693	256	"	47.0	19 57	3	7.1	7.0	4 22 84	7.1	4 20 87	7.1	4 9 88	7.05
1694	20	*Leonis*	47.1	1 35	3	6.4	6.5	5 16 84	6.35	4 21 87	6.35	4 30 89	6.45
1695	21	"	47.4	1 28	4	5.95	5.9	5 16 84	6.0	6 5 86	5.9	4 21 87	5.9
1696	257	*Hydræ*	47.4	19 28	5	5.55	5.4	4 22 84	5.5	4 22 86	5.4	4 9 88	5.6
1697	1	*Crateris*	47.4	14 47	5	6.75	6.8	4 26 84	6.7	4 21 87	6.75	4 22 87	6.7
1698	2	"	48.1	13 6	5	6.0	6.1	4 26 84	6.0	4 21 87	6.0	4 22 87	6.1
1699	258	*Hydræ*	49.1	20 0	3	6.85	6.9	4 22 84	6.9	4 20 87	6.9	4 9 88	6.8
1700	3	*Crateris*	52.8	18 56	5	7.0	7.0	4 26 84	6.9	4 21 87	7.0	4 22 87	7.0
1701	4	"	53.3	15 41	4	6.6	6.4	4 26 84	6.7	4 21 87	6.55	4 22 87	6.5
1702	5	"	53.7	17 38	4	4.4	4.4	4 26 84	4.4	3 6 86	4.4	4 22 86	4.4
1703	6	"	54.0	13 25	5	6.35	6.3	4 26 84	6.4	4 21 87	6.3	4 22 87	6.3
1704	7	"	54.8	15 7	4	6.65	6.7	4 26 84	6.5	4 21 87	6.75	4 22 87	6.65
1705	260	*Hydræ*	54.8	31 10	3	6.35	6.3	4 22 84	6.35	4 20 87	6.3	4 9 88	6.4
1706	28	*Leonis*	55.5	1 49	4	5.45	5.4	5 16 84	5.4	6 5 86	5.5	4 22 87	5.4
1707	29	"	56.3	2 50	4	7.0	7.0	5 16 84	7.05	6 5 86	7.0	4 9 88	6.95
1708	261	*Hydræ*	56.4	26 9	4	6.45	6.5	4 22 84	6.4	5 9 87	6.5	4 9 88	6.55
1709	30	*Leonis*	56.9	0 4	3	6.4	6.5	5 16 84	6.4	6 5 86	6.3	4 22 87	6.5
1710	262	*Hydræ*	57.0	24 54	3	6.8	6.7	4 22 84	6.8	5 9 87	6.75	4 9 88	6.8
1711	8	*Crateris*	57.0	10 37	3	5.75	5.7	4 26 84	5.7	4 21 87	5.75	4 9 88	5.75
1712	31	*Leonis*	57.2	+ 0 40	3	6.35	6.3	5 16 84	6.4	6 5 86	6.3	4 22 87	6.4
1713	263	*Hydræ*	57.3	−31 17	4	6.85	6.8	4 22 84	6.75	4 20 87	6.9	5 12 87	6.9
1714	9	*Crateris*	57.4	12 46	4	6.55	6.6	4 26 84	6.5	4 21 87	6.55	4 24 87	6.6
1715	10	"	57.8	18 59	4	6.7	6.7	4 26 84	6.6	4 21 87	6.75	4 22 87	6.75
1716	32	*Leonis*	57.9	0 36	3	6.95	6.9	5 16 84	6.9	6 5 86	7.0	4 22 87	6.9
1717	11	*Crateris*	59.3	10 25	3	6.25	6.2	4 26 84	6.2	4 21 87	6.3	4 9 88	6.25
1718	264	*Hydræ*	59.3	26 37	3	4.9	4.8	4 22 84	4.8	5 9 87	5.0	5 12 87	4.95
1719	265	"	10 59.9	26 37	4	6.2	6.4	4 22 84	6.0	5 12 87	6.3	5 14 87	6.2
1720	12	*Crateris*	11 0.5	12 20	5	6.6	6.6	4 26 84	6.5	4 21 87	6.55	4 24 87	6.6
1721	266	*Hydræ*	0.6	26 3	4	6.9	6.9	4 22 84	6.8	4 19 87	6.9	4 13 88	7.0
1722	267	"	0.9	29 53	5	6.95	6.9	4 22 84	7.1	4 19 87	6.9	5 12 87	6.9
1723	268	"	1.2	31 55	4	6.7	6.8	4 22 84	6.75	4 20 87	6.7	4 9 88	6.65
1724	35	*Leonis*	1.9	1 14	4	6.95	7.0	5 16 84	6.9	6 5 86	7.0	4 22 87	7.0
1725	269	*Hydræ*	2.0	29 30	4	6.65	6.7	4 22 84	6.7	4 19 87	6.6	4 13 88	6.5
1726	270	"	2.2	29 18	4	6.6	6.5	4 22 84	6.7	4 19 87	6.6	4 13 88	6.5
1727	271	"	2.7	27 24	3	5.7	5.8	4 22 84	5.7	5 12 87	5.6	4 13 88	5.75
1728	13	*Crateris*	2.8	18 44	4	6.8	6.8	4 26 84	6.85	4 21 87	6.8	4 22 87	6.8
1729	36	*Leonis*	2.9	0 39	3	6.95	6.9	5 16 84	6.9	6 5 86	7.0	4 22 87	6.9
1730	14	*Crateris*	3.9	6 42	2	6.9	6.7	5 16 84	6.9	4 22 87	6.9	.. .. ..	...
1731	272	*Hydræ*	3.9	31 41	6	6.0	5.9	4 22 84	5.85	4 20 87	5.9	4 9 88	6.0
1732	273	"	4.0	29 7	5	7.05	7.0	4 22 84	7.2	4 19 87	7.0	5 12 87	7.05
1733	15	*Crateris*	5.5	22 9	3	4.65	4.6	4 26 84	4.7	4 22 86	4.7	4 13 88	4.6
1734	274	*Hydræ*	5.9	26 8	4	6.8	6.9	4 22 84	6.8	5 12 87	6.7	4 13 88	7.0
1735	275	"	6.2	31 45	4	6.7	6.7	4 22 84	6.85	4 20 87	6.7	5 12 87	6.6
1736	16	*Crateris*	6.3	17 49	4	6.3	6.2	4 26 84	6.3	4 21 87	6.25	4 22 87	6.3
1737	17	"	6.4	21 4	3	6.7	6.8	4 26 84	6.7	4 21 87	6.8	4 30 89	6.65
1738	37	*Leonis*	7.4	+ 0 37	4	5.75	5.7	6 5 86	5.9	4 22 87	5.65	5 12 87	5.8
1739	18	*Crateris*	11 7.5	−22 19	2	6.9	6.9	4 26 84	6.9	4 21 87	6.9	.. .. ..	...

No.	U. A. No.	Name	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
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1740	40	*Leonis*	11 8.2	− 0 35	4	7.0	7.0	5 16 84	6.9	6 5 86	7.0	4 22 87	7.0
1741	19	*Crateris*	9.1	18 57	4	6.6	6.7	4 26 84	6.7	4 21 87	6.55	4 22 87	6.6
1742	20	"	9.6	22 14	2	6.85	6.8	4 26 84	6.85	4 21 87	6.85	.. .. ..	...
1743	41	*Leonis*	9.8	2 48	4	7.1	6.9	5 16 84	7.1	6 5 86	7.0	4 21 87	7.2
1744	42	"	10.2	3 17	3	6.75	6.7	5 16 84	6.7	6 5 86	6.8	4 21 87	6.8
1745	43	"	10.3	2 58	5	4.2	4.2	5 16 84	4.4	6 5 86	4.05	5 12 87	4.1
1746	21	*Crateris*	10.7	6 27	2	6.1	6.0	5 16 84	6.1	4 22 87	6.1	.. .. ..	...
1747	22	"	12.5	23 40	2	6.85	6.9	4 26 84	6.85	4 21 87	6.85	.. .. ..	...
1748	...	*Leonis*	13.0	0 58	3	6.95	6.9	5 16 84	6.9	6 5 86	7.0	4 22 87	7.0
1749	23	*Crateris*	13.1	14 6	4	3.7	3.8	4 26 84	3.65	4 22 86	3.7	4 29 86	3.8
1750	24	"	14.2	9 37	3	6.9	6.9	5 16 84	7.0	4 22 87	6.8	5 12 87	6.9
1751	25	"	16.2	8 10	3	6.9	6.9	5 16 84	7.0	4 22 87	6.8	5 12 87	6.9
1752	26	"	17.2	18 6	5	5.3	5.4	4 26 84	5.3	4 22 86	5.1	4 22 87	5.3
1753	52	*Leonis*	18.0	5 13	3	6.85	7.0	5 16 84	6.9	6 5 86	6.8	4 22 87	6.9
1754	27	*Crateris*	18.3	10 10	4	5.45	5.5	5 16 84	5.55	6 5 86	5.3	4 22 87	5.55
1755	53	*Leonis*	18.6	1 31	3	6.75	6.8	5 16 84	6.7	6 5 86	6.8	4 22 87	6.8
1756	28	*Crateris*	18.7	17 0	2	4.0	4.2	4 26 84	4.0	4 22 86	4.0	.. .. ..	...
1757	29	"	19.6	13 4	2	6.9	7.0	5 16 84	6.9	4 22 87	6.9	.. .. ..	...
1758	30	"	19.8	19 54	5	6.8	6.6	5 16 84	6.7	4 21 87	6.7	4 22 87	6.9
1759	31	"	20.3	20 40	3	6.7	6.8	5 16 84	6.7	4 21 87	6.7	4 22 87	6.7
1760	32	"	20.9	11 40	4	6.05	6.1	5 16 84	6.2	4 22 87	6.0	5 14 87	6.0
1761	280	*Hydræ*	21.4	25 11	2	6.9	6.9	4 26 84	6.9	4 20 87	6.9	.. .. ..	...
1762	59	*Leonis*	21.5	1 1	4	6.6	6.6	5 16 84	6.6	6 5 86	6.6	4 22 87	6.6
1763	60	"	21.7	0 13	3	6.95	7.0	5 16 84	6.9	6 5 86	7.0	4 22 87	6.9
1764	282	*Hydræ*	23.4	27 21	3	7.0	7.0	4 26 84	7.0	4 20 87	6.9	4 13 88	7.1
1765	33	*Crateris*	23.4	23 47	4	6.15	5.9	4 26 84	6.0	5 12 87	6.2	5 14 87	6.2
1766	62	*Leonis*	23.9	2 19	4	5.15	5.3	5 16 84	5.25	6 5 86	5.3	4 30 89	5.0
1767	283	*Hydræ*	24.1	25 7	3	6.85	6.9	4 26 84	6.9	4 20 87	6.85	4 30 89	6.8
1768	...	*Crateris*	24.3	12 21	4	6.95	...	5 16 84	6.9	4 22 87	6.9	4 20 90	7.0
1769	63	*Leonis*	25.6	5 47	3	6.85	6.9	5 16 84	6.9	6 5 86	6.8	4 22 87	6.9
1770	34	*Crateris*	25.6	20 5	3	6.4	6.4	5 16 84	6.5	4 22 87	6.35	5 12 87	6.4
1771	284-5	*Hydræ*	26.1	28 35	3	5.25	5.2	4 22 84	5.25	4 20 87	5.25	4 13 88	5.25
1772	286	"	26.2	26 4	3	6.5	6.6	4 26 84	6.4	4 20 87	6.6	5 12 87	6.5
1773	35	*Crateris*	26.4	7 8	3	6.35	6.4	5 16 84	6.3	6 5 86	6.4	4 22 87	6.4
1774	287	*Hydræ*	26.7	30 24	4	5.75	5.8	4 22 84	5.7	4 20 87	5.75	4 9 88	5.7
1775	36	*Crateris*	27.0	15 35	5	6.25	6.3	5 16 84	6.3	4 21 87	6.1	4 22 87	6.3
1776	37	"	27.8	15 21	5	7.1	7.0	5 16 84	6.9	4 21 87	7.15	5 12 87	7.2
1777	66	*Leonis*	28.0	4 50	3	6.85	6.8	5 16 84	6.9	6 5 86	6.8	4 22 87	6.8
1778	67	"	28.6	3 40	3	6.85	6.7	5 16 84	6.9	6 5 86	6.8	4 22 87	6.85
1779	38	*Crateris*	30.4	9 7	6	4.85	5.0	5 16 84	4.9	6 5 86	5.2	5 12 87	4.7
1780	69	*Leonis*	30.6	0 8	6	4.55	4.4	5 16 84	4.2	6 5 86	4.55	5 12 87	4.7
1781	39	*Crateris*	30.8	22 16	3	6.85	6.7	4 26 84	6.8	5 12 87	6.9	5 14 87	6.9
1782	3	*Virginis*	32.0	1 45	3	6.75	6.7	6 5 86	6.7	5 14 87	6.7	5 23 87	6.8
1783	41	*Crateris*	32.3	12 31	3	5.8	5.8	5 16 84	5.8	4 21 87	5.8	4 30 89	5.8
1784	40	"	32.7	24 1	3	6.6	6.5	4 26 84	6.6	5 12 87	6.65	4 30 89	6.5
1785	...	"	33.1	12 29	4	7.05	7.2	5 16 84	7.0	4 21 87	7.15	4 13 88	6.95
1786	42	"	33.5	13 47	4	6.25	6.2	5 16 84	6.25	4 21 87	6.3	4 13 88	6.25
1787	43	"	33.5	15 56	4	6.7	6.6	5 16 84	6.7	4 21 87	6.6	4 13 88	6.8
1788	294	*Hydræ*	34.9	28 31	3	6.65	6.7	4 22 84	6.6	4 20 87	6.7	5 7 88	6.65
1789	295	"	35.5	31 48	3	5.8	5.7	4 22 84	5.8	5 12 87	5.75	5 23 87	5.8
1790	44	*Crateris*	35.7	23 41	3	6.85	7.0	4 26 84	6.9	5 12 87	6.8	5 7 88	6.9
1791	45	"	35.8	19 36	2	6.5	6.4	5 16 84	6.5	4 22 87	6.5	.. .. ..	...
1792	46	"	11 37.2	14 21	4	6.9	6.8	5 16 84	6.9	4 21 87	6.8	4 13 88	6.95

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			h. m.	° ′									
1793	5	*Virginis*	11 37.5	− 5 59	2	6.4	6.4	5 25 84	6.4	6 5 86	6.4	.. .. ..	...
1794	296	*Hydræ*	37.7	29 3	5	7.0	7.0	4 22 84	6.8	4 20 87	7.0	5 12 87	7.05
1795	47	*Crateris*	38.1	20 0	4	6.8	6.9	5 16 84	6.7	4 22 87	6.8	5 7 88	6.85
1796	48	"	38.4	17 39	5	5.15	5.2	4 26 84	5.1	4 22 86	5.3	4 22 87	5.1
1797	297	*Hydræ*	41.0	29 35	2	6.8	6.8	4 22 84	6.8	4 20 87	6.8	.. .. ..	...
1798	49	*Crateris*	42.1	9 37	3	6.35	6.3	5 25 84	6.35	4 21 87	6.3	5 7 88	6.35
1799	50	"	42.3	13 39	4	7.0	7.0	5 16 84	6.9	4 21 87	7.0	4 13 88	7.05
1800	298	*Hydræ*	42.5	26 3	4	5.7	5.8	4 26 84	5.9	4 20 87	5.8	5 7 88	5.7
1801	51	*Crateris*	44.0	15 10	6	6.5	6.5	5 16 84	6.7	4 21 87	6.6	4 13 88	6.55
1802	11	*Virginis*	44.2	+ 2 28	2	3.6	3.7	5 25 84	3.6	5 23 87	3.6	.. .. ..	..
1803	299	*Hydræ*	44.3	−26 35	3	6.9	6.8	4 26 84	6.8	4 20 87	7.0	5 12 87	6.9
1804	12	*Virginis*	44.7	4 38	4	6.1	6.1	5 25 84	6.2	6 5 86	6.1	5 7 88	6.0
1805	..	*Crateris*	45.1	11 30	4	6.4	...	5 25 84	6.4	4 21 87	6.3	5 18 89	6.5
1806	300	*Hydræ*	45.4	30 8	3	6.3	6.2	4 22 84	6.3	4 20 87	6.3	4 30 89	6.35
1807	303	"	48.4	25 1	3	5.75	5.8	4 26 84	5.7	4 20 87	5.8	5 7 88	5.7
1808	...	*Virginis*	49.0	4 26	4	7.0	...	5 25 84	6.95	5 14 87	7.0	5 18 89	7.1
1809	52	*Crateris*	49.2	24 10	4	7.05	6.9	4 26 84	7.1	4 20 87	7.0	5 12 87	7.05
1810	304	*Hydræ*	49.3	27 47	4	6.5	6.5	4 26 84	6.3	4 20 87	6.55	5 12 87	6.6
1811	53	*Crateris*	49.7	16 27	3	5.45	5.4	4 26 84	5.4	4 22 86	5.5	4 13 88	5.4
1812	...	*Hydræ*	50.4	31 34	5	7.0	7.0	4 22 84	7.1	4 20 87	7.0	5 12 87	7.0
1813	1	*Corvi*	50.5	13 3	5	6.65	6.7	5 25 84	6.5	4 21 87	6.7	4 27 87	6.7
1814	2	"	50.6	11 25	5	7.05	7.0	5 25 84	7.1	4 21 87	7.0	4 27 87	7.0
1815	16	*Virginis*	50.6	4 5	2	6.8	6.7	5 25 84	6.8	6 4 86	6.8	.. .. ..	...
1816	306	*Hydræ*	51.2	26 21	4	7.0	7.0	4 26 84	7.05	4 20 87	7.0	5 22 87	7.1
1817	17	*Virginis*	51.4	7 51	3	6.7	6.8	5 25 84	6.7	6 4 86	6.7	5 18 89	6.7
1818	18	"	51.7	3 41	2	6.8	6.9	5 25 84	6.8	6 4 86	6.8	.. .. .	.
1819	307	*Hydræ*	51.7	30 57	4	7.05	7.0	4 22 84	7.1	4 20 87	7.0	6 8 87	7.0
1820	308	"	52.5	25 13	3	6.5	6.7	4 26 84	6.5	4 20 87	6.55	5 7 88	6.5
1821	20	*Virginis*	52.8	9 47	3	6.95	7.0	5 25 84	6.9	6 4 86	7.0	4 27 87	6.9
1822	309	*Hydræ*	53.0	29 22	4	7.05	7.0	4 26 84	7.1	4 20 87	7.0	5 12 87	7.0
1823	22	*Virginis*	53.2	1 13	4	7.05	7.0	5 25 84	7.0	6 4 86	7.1	5 14 87	7.1
1824	24	"	54.3	9 44	3	5.9	5.9	5 25 84	5.9	6 4 86	5.8	5 18 89	6.0
1825	3	*Corvi*	54.3	21 9	4	6.45	6.5	4 26 84	6.4	4 27 87	6.5	5 7 88	6.6
1826	4	"	54.5	18 58	4	5.5	5.5	4 26 84	5.6	4 22 86	5.4	4 27 87	5.5
1827	26	*Virginis*	54.6	1 4	2	6.7	6.6	5 25 84	6.7	6 4 86	6.7	.. .. ..	...
1828	27	"	56.5	6 59	3	6.65	6.6	5 25 84	6.6	6 4 86	6.7	5 18 89	6.7
1829	28	"	57.2	4 47	4	6.9	7.0	5 25 84	6.8	6 4 86	6.8	5 18 89	7.0
1830	30	"	57.6	9 36	4	6.75	6.8	5 25 84	6.8	6 4 86	6.8	4 27 87	6.7
1831	31	"	59.2	5 9	2	6.8	6.7	5 25 84	6.8	6 4 86	6.8	.. .. ..	...
1832	33	"	11 59.6	2 26	3	6.55	6.7	5 25 84	6.55	6 4 86	6.6	5 7 88	6.5
1833	5	*Corvi*	12 0.4	11 33	6	6.8	6.6	5 25 84	6.7	4 27 87	6.85	5 12 87	7.0
1834	6	"	0.6	23 4	3	6.9	6.9	6 9 82	7.0	4 26 84	6.8	4 22 86	6.9
1835	7	"	1.0	17 30	3	6.95	7.0	4 26 84	7.0	5 16 84	7.0	4 29 86	6.9
1836	8	"	1.2	23 16	3	6.8	6.9	6 9 82	6.9	4 26 84	6.8	4 22 86	6.7
1837	9	"	2.0	24 2	3	4.2	4.2	4 26 84	4.3	4 29 86	4.1	5 12 87	4.2
1838	...	"	2.5	17 44	5	6.9	...	5 16 84	6.9	4 29 86	6.9	5 7 88	6.8
1839	10	"	3.0	11 9	2	6.7	6.6	5 25 84	6.7	4 27 87	6.7	.. .. ..	...
1840	11	"	3.7	16 50	4	6.7	6.7	4 26 84	6.7	5 16 84	6.6	4 29 86	6.7
1841	12	"	3.7	21 56	3	3.4	3.3	6 9 82	3.35	4 26 84	3.4	4 29 86	3.5
1842	36	*Virginis*	4.0	7 5	3	6.6	6.7	5 25 84	6.55	6 4 86	6.7	5 14 87	6.55
1843	13	*Corvi*	4.6	22 54	4	5.75	5.8	6 9 82	5.7	4 26 84	5.85	4 22 86	5.7
1844	14	"	5.0	16 6	3	6.85	6.8	4 26 84	6.9	5 16 84	6.8	4 29 86	6.9
1845	37	*Virginis*	12 5.0	2 0	3	6.95	6.9	5 25 84	7.0	6 4 86	6.9	6 1 88	7.0

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations Date.	Mag	Date.	Mag.	Date	Mag.
			h m.	° ′									
1846	38	*Virginis*	12 5.0	− 3 5	2	6.9	7.0	5 25 84	6.9	6 4 86	6.9	.. .. ..	...
1847	40	"	7.9	5 2	5	6.6	6.6	5 25 84	6.4	6 4 86	6.7	5 14 87	6.55
1848	15	*Corvi*	8.5	20 9	4	6.2	6.2	6 9 82	6.1	4 26 84	6.4	5 9 85	6.1
1849	318	*Hydræ*	8.6	28 32	3	6.85	6.7	4 26 84	6.8	5 12 87	6.9	5 14 87	6.85
1850	41	*Virginis*	8.7	9 35	4	6.3	6.2	5 25 84	6.2	6 4 86	6.4	5 14 87	6.2
1851	16	*Corvi*	9.2	19 50	3	6.95	7.0	6 9 82	7.0	4 26 84	6.9	4 27 87	7.0
1852	17	"	9.3	22 39	5	6.75	6.7	6 9 82	6.8	4 26 84	6.8	5 9 85	6.8
1853	18	"	9.4	16 51	3	2.4	2.5	6 9 82	2.35	4 26 84	2.4	4 29 86	2.4
1854	19	"	10.6	16 0	5	6.3	6.2	4 26 84	6.2	5 16 84	6.4	4 29 86	6.4
1855	20	"	11.5	23 19	4	6.9	7.0	6 9 82	6.9	4 26 84	6.8	4 22 86	7.1
1856	42	*Virginis*	11.8	3 15	3	6.15	6.3	4 27 84	6.2	6 4 86	6.1	5 14 87	6.2
1857	43	"	12.3	0 6	2	6.2	6.1	5 25 84	6.2	6 4 86	6.2	.. .. ..	...
1858	44	"	12.9	8 13	3	6.95	6.9	5 25 84	7.0	6 4 86	6.8	5 14 87	7.0
1859	319	*Hydræ*	13.4	26 3	3	6.85	7.0	4 26 84	6.8	5 12 87	6.95	5 14 87	6.85
1860	45	*Virginis*	13.5	+ 0 2	6	3.85	4.0	5 25 84	3.7	5 31 86	3.8	6 5 86	4.0
1861	21	*Corvi*	13.7	−21 29	5	6.45	6.4	6 9 82	6.4	4 26 84	6.7	5 9 85	6.3
1862	22	"	14.1	21 31	3	5.3	5.3	6 9 82	5.3	4 26 84	5.3	4 22 86	5.3
1863	23	"	14.5	12 52	5	5.65	5.7	6 9 82	5.6	6 13 82	5.6	5 9 85	5.7
1864	24	"	15.8	14 52	6	6.85	6.9	6 9 82	6.9	6 13 82	6.9	4 26 84	6.9
1865	48	*Virginis*	16.7	6 36	3	6.95	7.0	5 25 84	7.0	6 4 86	6.9	6 1 88	6.95
1866	49	"	16.8	4 17	2	6.7	6.6	4 27 84	6.7	6 4 86	6.7	.. .. ..	...
1867	25	*Corvi*	16.9	24 9	4	5.95	6.0	6 9 82	6.1	4 26 84	6.0	4 22 86	5.9
1868	26	"	16.9	11 7	3	6.75	6.8	6 9 82	6.7	6 13 82	6.8	5 9 85	6.7
1869	320	*Hydræ*	17.3	29 39	3	6.85	6.8	4 26 84	6.8	5 12 87	6.9	5 14 87	6.85
1870	321	"	18.7	25 18	3	6.9	7.0	4 26 84	6.8	5 12 87	6.95	5 14 87	6.9
1871	322	"	18.8	27 3	3	6.6	6.6	4 26 84	6.6	5 12 87	6.6	5 14 87	6.6
1872	50	*Virginis*	18.8	10 55	6	6.15	6.1	6 9 82	6.2	6 13 82	6.2	5 9 85	6.3
1873	27	*Corvi*	21.3	15 56	5	6.65	6.8	6 9 82	6.7	6 13 82	6.7	5 16 84	6.6
1874	52	*Virginis*	21.5	3 55	2	6.4	6.3	4 27 84	6.4	6 4 86	6.4	.. .. ..	...
1875	53	"	21.5	7 59	2	6.8	6.7	5 25 84	6.8	6 4 86	6.8	.. .. ..	...
1876	...	"	22.8	1 44	3	6.95	..	4 27 84	6.9	5 15 87	7.0	6 11 88	6.95
1877	28	*Corvi*	23.4	15 49	3	2.85	3.0	6 9 82	2.95	4 26 84	2.7	4 29 86	2.9
1878	29	"	23.7	12 42	3	6.5	6.6	6 9 82	6.5	6 13 82	6.5	5 9 85	6.5
1879	30	"	23.8	23 0	8	6.35	6.2	6 9 82	6.4	5 9 85	6.3	4 22 86	6.3
1880	324	*Hydræ*	25.0	30 18	3	6.9	7.0	4 26 84	6.9	5 12 87	6.9	5 14 87	6.9
1881	57	*Virginis*	25.2	4 22	3	6.5	6.5	4 27 84	6.5	6 4 86	6.5	6 1 88	6.55
1882	31	*Corvi*	25.7	15 30	3	4.6	4.5	4 26 84	4.6	4 29 86	4.5	5 7 88	4.8
1883	...	*Virginis*	25.7	1 4	3	7.0	...	4 27 84	7.0	5 15 87	7.1	6 1 88	6.95
1884	32	*Corvi*	26.0	20 31	4	6.6	6.7	6 9 82	6.7	4 22 86	6.6	4 29 86	6.6
1885	33	"	26.2	13 10	5	6.05	5.9	6 9 82	6.2	6 13 82	6.1	5 9 85	6.1
1886	326	*Hydræ*	26.2	29 21	3	6.9	7.0	4 26 84	6.9	5 12 87	6.9	5 14 87	6.9
1887	34	*Corvi*	26.9	19 6	6	6.45	6.2	6 9 82	6.5	6 13 82	6.5	5 9 85	6.5
1888	35	"	27.1	12 9	4	6.0	5.8	6 9 82	6.0	6 13 82	5.9	5 9 85	6.1
1889	59	*Virginis*	27.3	8 46	3	5.6	5.7	6 9 82	5.7	5 31 86	5.5	5 15 87	5.6
1890	36	*Corvi*	27.8	22 42	3	2.8	2.6	6 9 82	2.75	4 26 84	2.95	4 29 86	2.7
1891	60	*Virginis*	28.0	0 43	3	7.0	7.0	4 27 84	7.0	6 4 86	7.0	6 1 88	6.95
1892	37	*Corvi*	29.2	16 8	3	6.85	6.9	6 9 82	6.9	5 16 84	6.8	5 7 88	6.8
1893	40	"	29.4	19 50	6	6.25	6.4	6 9 82	6.2	6 13 82	6.3	5 9 85	6.2
1894	63	*Virginis*	30.4	5 9	2	6.0	6.0	4 27 84	6.0	6 4 86	6.0	.. .. ..	...
1895	64	"	30.7	1 38	5	6.85	6.7	4 27 84	6.7	6 4 86	6.8	6 1 88	6.85
1896	66	"	30.9	7 37	3	6.85	6.7	6 9 82	6.8	6 4 86	6.9	6 1 88	6.9
1897	328	*Hydræ*	31.1	26 27	3	5.55	5.6	4 26 84	5.6	6 4 86	5.5	6 1 88	5.55
1898	41	*Corvi*	12 32.2	17 34	6	6.15	6.0	6 9 82	6.2	6 13 82	6.2	5 9 85	6.0

No.	U. A. No.	Name	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U.A.	Separate Observations. Date.	Mag	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
1899	71	*Virginis*	12 32.3	− 3 41	5	6.75	6.8	4 27 84	6.6	6 4 86	6.65	6 1 88	6.75
1900	329	*Hydræ*	32.4	29 44	3	6.4	6.4	4 26 84	6.4	5 12 87	6.4	5 14 87	6.4
1901	72	*Virginis*	32.6	0 10	3	6.9	7.0	4 27 84	6.9	6 4 86	6.9	6 1 88	6.9
1902	73	"	32.8	7 18	3	5.05	5.2	6 9 82	5.1	5 31 86	5.0	6 1 88	5.05
1903	74	"	33.1	5 25	2	6.95	7.0	4 27 84	6.95	6 4 86	6.95	.. .. ..	...
1904	42	*Corvi*	34.1	13 25	4	6.9	6.9	6 9 82	6.9	6 13 82	6.9	5 9 85	6.9
1905	43–4	"	34.8	12 20	7	5.45	5.7	6 9 82	5.4	6 13 82	5.5	5 9 85	5.5
1906	45	"	35.3	19 4	6	6.15	6.2	6 9 82	6.0	6 13 82	6.0	5 9 85	6.2
1907	75–6	*Virginis*	35.3	0 46	2	3.2	3.1	5 25 84	3.2	5 31 86	3.2	.. .. ..	...
1908	77	"	35.5	6 49	3	7.0	7.0	6 9 82	7.0	6 4 86	6.95	6 1 88	7.0
1909	46	*Corvi*	37.0	13 10	5	6.9	6.9	6 9 82	6.9	6 13 82	6.9	5 9 85	6.9
1910	79	*Virginis*	37.2	0 53	3	6.35	6.1	4 27 84	6.3	6 4 86	6.4	5 15 87	6.4
1911	47	*Corvi*	37.3	11 20	4	6.8	6.8	6 9 82	6.8	6 13 82	6.8	5 9 85	6.8
1912	48	"	37.4	12 27	4	6.9	6.9	6 9 82	6.9	6 13 82	6.9	5 9 85	6.9
1913	330	*Hydræ*	37.4	27 38	4	5.9	5.9	4 26 84	5.8	6 4 86	5.8	6 1 88	6.1
1914	80	*Virginis*	37.8	2 9	3	6.7	6.7	4 27 84	6.7	6 4 86	6.65	6 1 88	6.7
1915	331	*Hydræ*	38.6	28 5	3	7.0	7.0	4 26 84	7.0	6 4 86	6.9	6 1 88	7.05
1916	81	*Virginis*	38.9	3 12	5	6.75	6.8	4 27 84	6.9	6 4 86	6.65	5 17 87	6.9
1917	49	*Corvi*	39.3	21 5	3	7.1	7.0	6 9 82	7.1	4 27 87	7.1	5 7 88	7.1
1918	50	"	40.1	11 8	3	6.9	6.9	6 9 82	6.9	6 13 82	6.9	5 9 85	6.9
1919	85	*Virginis*	41.1	5 37	3	6.55	6.6	4 27 84	6.6	6 4 86	6.5	6 1 88	6.55
1920	332	*Hydræ*	41.3	24 10	4	6.5	6.4	4 26 84	6.65	6 4 86	6.6	6 1 88	6.35
1921	...	"	41.3	24 20	3	7.0	7.2	4 26 84	7.1	6 4 86	6.9	5 12 87	7.0
1922	333	"	41.8	26 55	3	6.05	6.0	4 26 84	6.05	6 4 86	6.1	6 1 88	5.95
1923	51	*Corvi*	43.2	15 12	5	6.95	7.0	4 26 84	6.85	4 27 87	7.0	5 12 87	7.1
1924	87	*Virginis*	43.7	6 57	3	6.95	7.0	6 9 82	7.0	6 4 86	6.95	6 1 88	6.95
1925	88	"	44.9	9 39	3	6.65	6.6	6 9 82	6.6	5 31 86	6.7	6 1 88	6.7
1926	334	*Hydræ*	45.3	26 4	4	6.4	6.3	4 26 84	6.3	6 4 86	6.5	5 12 87	6.4
1927	90	*Virginis*	46.8	2 52	4	6.2	6.2	7 7 82	6.2	5 31 86	6.2	6 4 86	6.3
1928	91	"	47.2	3 33	3	6.55	6.6	7 7 82	6.6	5 31 86	6.5	6 1 88	6.55
1929	52	*Corvi*	47.4	17 22	3	6.8	6.8	4 26 84	6.8	4 27 87	6.9	5 7 88	6.7
1930	92	*Virginis*	47.8	10 58	4	6.1	6.1	6 9 82	6.0	5 15 87	6.15	5 23 87	6.2
1931	93	"	47.9	8 52	6	5.4	5.2	6 9 82	5.4	5 31 86	5.2	5 15 87	5.4
1932	335	*Hydræ*	48.8	29 24	3	6.9	6.9	4 26 84	6.9	6 5 86	7.0	6 1 88	6.85
1933	53	*Corvi*	49.3	14 39	4	6.4	6.4	4 26 84	6.5	4 27 87	6.35	5 12 87	6.35
1934	94	*Virginis*	49.3	+ 0 44	3	6.8	6.8	6 5 86	6.75	5 15 87	6.85	6 1 88	6.8
1935	95	"	49.3	+ 4 5	3	3.8	3.5	5 25 84	3.85	5 31 86	3.7	5 15 87	3.9
1936	96	"	49.8	− 4 11	4	6.85	6.8	7 7 82	6.8	5 31 86	6.8	6 1 88	7.0
1937	336	*Hydræ*	49.8	25 47	4	6.85	6.9	4 26 84	7.0	6 4 86	6.9	6 1 88	6.85
1938	97	*Virginis*	50.0	0 16	4	6.65	6.7	5 24 84	6.7	6 5 86	6.6	6 1 88	6.55
1939	98	"	50.7	11 23	8	6.6	6.8	6 9 82	6.4	5 31 86	6.65	5 17 87	6.55
1940	99	"	50.8	8 14	3	6.95	6.9	6 9 82	7.0	5 31 86	6.9	6 11 88	6.95
1941	337	*Hydræ*	50.9	22 5	4	6.65	6.6	4 26 84	6.85	5 12 87	6.6	5 23 87	6.55
1942	338	"	51.5	22 23	3	6.9	7.0	4 26 84	6.85	5 12 87	6.95	5 23 87	6.95
1943	102	*Virginis*	52.2	2 14	5	6.95	6.9	7 7 82	6.9	5 31 86	7.1	5 15 87	7.1
1944	103	"	52.3	20 52	3	6.85	6.9	6 13 82	6.8	4 26 84	6.85	6 1 88	6.95
1945	104	"	53.2	3 8	3	5.85	5.9	7 7 82	5.8	5 31 86	5.9	6 1 88	5.9
1946	105	"	54.2	2 42	3	6.2	6.1	7 7 82	6.2	5 31 86	6.2	6 1 88	6.2
1947	339	*Hydræ*	55.6	27 37	2	6.9	6.9	4 26 84	6.9	6 5 86	6.9	.. .. ..	...
1948	340	"	55.6	28 36	2	6.9	6.9	4 26 84	6.9	6 5 86	6.9	.. .. ..	...
1949	106	*Virginis*	57.1	19 55	3	6.05	5.9	6 13 82	6.1	4 26 84	6.0	5 28 86	6.0
1950	107	"	57.5	2 59	3	6.6	6.7	7 7 82	6.6	5 31 86	6.6	6 1 88	6.55
1951	...	*Hydræ*	12 57.6	27 44	4	7.1	7.1	4 26 84	6.9	6 5 86	7.0	6 1 88	7.2

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			h. m.	° ′									
1952	108	*Virginis*	12 58.4	+ 0 58	2	7.0	7.0	6 5 86	7.0	5 15 87	7.0	.. .. ..	...
1953	109	"	13 1.4	−10 4	2	5.6	5.6	6 9 82	5.6	5 31 86	5.6	.. .. ..	...
1954	110	"	2.0	8 19	3	6.0	5.9	6 9 82	6.0	5 31 86	6.1	6 1 88	5.95
1955	341	*Hydræ*	2.3	22 27	3	5.35	5.3	4 26 84	5.3	6 5 86	5.4	6 2 88	5.4
1956	112	*Virginis*	2.7	8 52	4	6.55	6.7	6 9 82	6.5	5 31 86	6.65	5 15 87	6.55
1957	113	"	3.1	15 51	4	6.75	6.8	6 13 82	6.65	5 28 86	6.7	6 1 88	6.8
1958	114	"	3.2	9 40	5	6.35	6.3	6 9 82	6.3	5 31 86	6.4	6 4 86	6.3
1959	115	"	3.6	4 52	5	4.55	4.7	6 13 82	4.8	6 5 86	4.4	6 8 87	4.4
1960	116	"	4.5	16 25	3	6.9	7.0	6 13 82	6.8	5 28 86	7.0	5 23 87	6.9
1961	342	*Hydræ*	4.9	25 53	2	6.7	6.6	4 26 84	6.7	6 5 86	6.7	.. .. ..	...
1962	117	*Virginis*	5.4	15 31	4	5.35	5.3	6 13 82	5.3	5 28 86	5.4	6 1 88	5.45
1963	118-9	"	6.8	18 10	3	6.4	6.4	6 13 82	6.4	5 28 86	6.4	6 1 88	6.45
1964	120	"	7.5	19 17	5	5.65	5.8	6 13 82	5.6	4 26 84	5.75	5 28 86	5.6
1965	343	*Hydræ*	7.7	23 37	3	6.85	6.9	4 26 84	6.85	6 5 86	6.8	6 1 88	6.9
1966	122	*Virginis*	8.2	9 42	4	7.0	7.0	6 9 82	7.0	5 25 84	7.0	6 4 86	7.0
1967	123	"	8.4	10 42	4	6.95	6.9	6 9 82	7.0	5 25 84	6.9	6 4 86	6.9
1968	124	"	9.2	19 17	3	5.6	5.7	6 13 82	5.6	5 28 86	5.6	6 1 88	5.65
1969	125	"	10.0	0 44	3	6.7	6.8	5 24 84	6.7	6 5 86	6.6	6 3 88	6.8
1970	126	"	10.8	10 49	4	6.85	6.9	6 9 82	6.8	5 25 84	6.9	6 4 86	6.9
1971	127	"	10.9	14 53	3	6.9	6.9	6 13 82	6.8	5 28 86	7.0	5 23 87	6.95
1972	128	"	10.9	9 53	4	7.0	7.0	6 9 82	7.0	5 25 84	7.0	6 4 86	7.0
1973	129	"	11.1	0 1	3	6.55	6.5	5 24 84	6.6	6 5 86	6.5	6 3 88	6.5
1974	344	*Hydræ*	11.5	27 40	3	6.9	7.0	4 26 84	6.9	6 5 86	6.95	6 2 88	6.85
1975	131	*Virginis*	11.9	17 37	3	5.0	5.3	6 13 82	5.0	5 28 86	5.0	6 1 88	5.0
1976	345	*Hydræ*	12.1	22 31	3	3.2	3.2	4 26 84	3.2	4 29 86	3.2	6 5 86	3.2
1977	133	*Virginis*	13.8	10 39	3	7.0	7.0	6 9 82	7.0	5 25 84	7.0	6 1 88	7.0
1978	135	"	14.8	18 50	3	6.4	6.4	6 13 82	6.4	5 28 86	6.5	6 1 88	6.3
1979	138	"	16.0	5 32	4	6.85	6.9	6 13 82	6.8	7 7 82	6.9	6 5 86	6.8
1980	139	"	16.3	17 5	5	5.7	5.5	6 13 82	5.8	5 28 86	5.65	5 15 87	5.75
1981	140	"	16.8	4 16	6	6.4	6.1	6 13 82	6.2	6 5 86	6.6	6 20 86	6.3
1982	141	"	17.2	20 16	4	6.8	6.9	6 13 82	6.9	5 28 86	6.75	5 23 87	6.7
1983	143	"	18.1	4 31	4	6.0	6.0	6 13 82	6.1	6 5 86	6.0	6 1 88	5.9
1984	145	"	19.4	16 13	3	6.9	6.9	6 13 82	6.9	5 28 86	7.0	6 3 88	6.8
1985	146	"	19.8	0 33	5	6.2	6.2	5 24 84	6.4	6 5 86	6.25	5 15 87	6.2
1986	147	"	20.1	12 3	2	5.8	5.7	6 13 82	5.8	5 31 86	5.8	.. .. ..	...
1987	148	"	20.8	15 20	4	5.05	5.0	6 13 82	5.0	5 28 86	5.1	5 6 88	5.05
1988	346	*Hydræ*	21.1	25 45	4	6.9	6.9	5 17 84	6.9	5 16 85	6.9	6 5 86	6.8
1989	149	*Virginis*	22.7	18 5	4	7.15	7.0	6 13 82	7.1	5 28 86	7.1	6 3 88	7.25
1990	150	"	22.8	0 43	3	6.65	6.8	5 24 84	6.6	6 5 86	6.6	6 29 88	6.75
1991	154	"	23.9	5 49	7	6.45	6.7	6 13 82	6.4	7 7 82	6.7	6 5 86	6.4
1992	155	"	24.6	12 48	3	6.95	7.0	6 13 82	7.0	6 4 86	6.9	6 3 88	6.9
1993	348	*Hydræ*	24.6	27 28	3	6.75	6.7	5 17 84	6.7	5 16 85	6.7	6 5 86	6.8
1994	156	*Virginis*	25.3	18 5	4	6.3	6.2	6 13 82	6.4	5 28 86	6.3	6 3 88	6.2
1995	157	"	25.5	5 37	5	5.25	5.1	6 13 82	5.1	5 31 86	5.2	6 5 86	5.4
1996	349	*Hydræ*	25.6	28 55	3	6.7	6.8	5 17 84	6.7	5 16 85	6.7	6 5 86	6.7
1997	350	"	25.7	28 3	3	6.05	5.9	5 17 84	6.05	5 16 85	6.1	6 5 86	6.0
1998	158	*Virginis*	26.2	14 43	4	6.0	6.0	6 13 82	6.1	5 28 86	5.9	5 31 86	6.1
1999	159	"	26.4	9 31	4	5.8	5.8	6 13 82	5.8	5 31 86	5.8	6 5 86	5.7
2000	...	"	26.9	7 48	3	6.95	7.0	6 13 82	6.9	7 7 82	7.0	6 5 86	6.9
2001	161	"	26.9	6 59	4	6.95	7.0	6 13 82	6.9	7 7 82	7.0	6 5 86	6.9
2002	164	"	27.8	12 42	3	7.4	7.0	6 20 86	7.3	6 17 90	7.5	6 19 90	7.4
2003	165	"	28.0	12 34	20	6.15	var.	4 18 82	6.25	4 20 82	6.1	4 23 82	6.1
2004	166	"	13 27.9	+ 0 20	5	7.15	7.0	5 24 84	7.0	6 5 86	7.15	5 15 87	7.2

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			h. m.	° ′									
2005	167	*Virginis*	13 28.3	+ 0 3	2	3.5	3.6	5 25 84	3.5	5 31 86	3.5	.. .. ..	...
2006	168	"	28.7	−21 23	3	6.95	6.9	5 17 84	6.9	5 16 85	7.0	6 5 86	7.0
2007	169	"	29.0	4 46	5	6.25	6.1	6 13 82	6.4	6 5 86	6.2	5 23 87	6.2
2008	170	"	29.9	0 17	2	6.9	6.9	5 24 84	6.9	6 5 86	6.9	.. .. ..	...
2009	351	*Hydræ*	29.9	25 51	4	5.75	5.8	5 17 84	5.7	5 16 85	5.7	6 5 86	5.85
2010	352	"	30.3	22 59	3	6.85	7.0	5 17 84	6.9	5 16 85	6.9	6 5 86	6.8
2011	171	*Virginis*	31.3	2 36	3	6.9	6.9	5 24 84	6.9	6 5 86	6.95	6 29 88	6.9
2012	353	*Hydræ*	31.4	29 12	3	7.1	7.0	5 17 84	7.1	5 16 85	7.1	6 5 86	7.1
2013	354	"	31.7	28 55	4	6.3	6.3	5 17 84	6.3	5 16 85	6.3	6 5 86	6.2
2014	355	"	34.6	22 49	4	6.6	6.6	5 17 84	6.7	5 16 85	6.6	6 5 86	6.5
2015	173	*Virginis*	35.1	8 4	4	5.65	5.7	6 13 82	5.6	5 31 86	5.6	6 5 86	5.7
2016	176	"	37.0	3 39	2	7.0	7.0	5 24 84	7.0	6 5 86	7.0	.. .. ..	...
2017	177	"	37.4	4 52	3	6.55	6.5	5 24 84	6.5	6 5 86	6.6	6 2 88	6.55
2018	178	"	37.8	15 33	3	6.0	6.0	6 21 82	6.0	5 28 86	6.0	6 3 88	6.05
2019	356	*Hydræ*	37.8	24 52	4	6.6	6.5	5 17 84	6.7	5 16 85	6.6	6 5 86	6.5
2020	357	"	38.7	25 29	3	6.05	6.1	5 17 84	6.0	5 16 85	6.1	6 5 86	6.0
2021	179	*Virginis*	38.9	15 8	4	6.35	6.5	6 21 82	6.3	5 28 86	6.5	5 23 87	6.35
2022	180	"	39.3	11 48	4	5.85	5.9	6 21 82	5.8	5 31 86	5.8	6 20 86	6.0
2023	182	"	40.4	18 38	3	6.85	6.9	6 21 82	6.8	5 28 86	6.9	6 3 88	6.8
2024	183	"	40.6	9 5	3	6.55	6.6	6 5 86	6.6	6 20 86	6.5	6 3 88	6.6
2025	184	"	40.6	17 14	3	5.85	5.8	6 21 82	5.8	5 28 86	5.9	6 3 88	5.85
2026	186	"	40.9	6 5	4	6.95	7.0	5 24 84	6.9	6 5 86	6.95	6 3 88	7.1
2027	187	"	41.8	6 13	2	6.8	6.8	5 24 84	6.8	6 5 86	6.8	.. .. ..	...
2028	358	*Hydræ*	42.0	27 45	..	var.	7.0	.. .. ..	...	.. .. ..	..	.. .. ..	...
2029	188	*Virginis*	42.2	2 13	2	7.0	7.0	5 24 84	7.0	6 5 86	7.0	.. .. ..	...
2030	359	*Hydræ*	43.0	28 28	3	6.45	6.5	5 17 84	6.4	6 5 86	6.4	6 2 88	6.5
2031	190	*Virginis*	43.1	17 31	5	5.45	5.4	6 21 82	5.5	5 28 86	5.3	5 23 87	5.45
2032	193	"	43.7	19 17	3	6.65	6.7	6 21 82	6.6	5 28 86	6.6	6 3 88	6.7
2033	360	*Hydræ*	44.5	23 46	4	6.65	6.7	5 17 84	6.7	5 16 85	6.6	6 5 86	6.5
2034	195	*Virginis*	45.8	18 5	4	7.05	6.9	6 21 82	7.0	5 28 86	6.9	6 3 88	7.15
2035	361	*Hydræ*	47.2	27 57	3	6.55	6.5	5 17 84	6.55	6 5 86	6.6	6 2 88	6.5
2036	...	"	47.2	28 8	4	7.0	...	5 17 84	7.0	6 5 86	6.9	6 2 88	7.15
2037	196	*Virginis*	47.6	16 34	5	6.85	6.8	6 21 82	6.8	5 28 86	6.9	5 14 87	6.85
2038	197	"	47.6	21 38	3	6.9	6.8	5 17 84	6.9	5 16 85	6.8	6 5 86	7.0
2039	198	"	48.3	0 53	5	5.65	5.6	5 24 84	5.8	6 5 86	5.5	5 23 87	5.5
2040	199	"	48.4	7 27	3	6.55	6.4	7 13 82	6.5	6 5 86	6.6	6 3 88	6.5
2041	200	"	49.2	8 57	3	6.8	6.8	7 13 82	6.8	6 5 86	6.7	6 3 88	6.9
2042	201	"	49.3	9 9	5	6.95	7.0	7 13 82	6.9	6 5 86	6.7	5 23 87	7.05
2043	362	*Hydræ*	49.4	27 2	4	7.0	7.0	5 17 84	7.0	6 5 86	6.9	5 6 88	7.1
2044	...	"	49.8	27 3	4	7.7	8.0	6 5 86	7.6	5 23 87	7.7	5 6 88	7.7
2045	202	*Virginis*	50.1	+ 1 40	2	6.2	6.2	5 24 84	6.2	5 23 87	6.2	.. .. ..	...
2046	363	*Hydræ*	50.5	−22 25	5	6.5	6.7	5 17 84	6.5	5 16 85	6.5	6 5 86	6.7
2047	364	"	50.9	25 23	5	6.85	6.9	5 17 84	6.7	6 5 86	6.8	6 2 88	6.95
2048	365	"	51.5	24 22	3	5.7	5.7	5 17 84	5.8	6 5 86	5.6	5 23 87	5.7
2049	203	*Virginis*	51.8	13 31	4	6.9	7.0	6 21 82	6.9	6 5 86	6.9	5 14 87	6.85
2050	366	*Hydræ*	53.0	24 24	3	6.25	6.3	5 17 84	6.3	6 5 86	6.2	6 2 88	6.2
2051	204	*Virginis*	53.3	2 56	6	6.55	6.7	6 21 82	6.7	5 24 84	6.5	6 5 86	6.4
2052	205	"	53.5	7 33	3	6.9	6.8	7 13 82	6.9	6 5 86	6.9	6 3 88	6.9
2053	...	*Hydræ*	53.5	25 39	4	7.0	...	5 17 84	6.8	6 5 86	7.0	5 14 87	7.05
2054	367	"	55.3	26 50	4	6.1	6.0	5 17 84	6.05	6 5 86	6.2	5 14 87	6.1
2055	207	*Virginis*	56.3	16 46	6	6.65	6.6	6 21 82	6.7	6 5 86	6.7	5 14 87	6.7
2056	208	"	56.9	21 49	4	6.5	6.3	5 17 84	6.5	5 16 85	6.5	6 5 86	6.5
2057	210	"	13 57.7	14 22	5	6.55	6.5	6 21 82	6.5	6 5 86	6.7	5 14 87	6.5

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			h. m.	° ′									
2058	211	*Virginis*	13 57.7	− 4 47	5	6.85	6.7	5 24 84	6.7	6 5 86	6.8	6 3 88	6.85
2059	212	"	57.7	8 39	4	6.7	6.8	7 13 82	6.7	6 5 86	6.7	6 3 88	6.6
2060	214	"	58.4	15 44	5	6.65	6.8	6 5 86	6.7	5 14 87	6.6	6 3 88	6.55
2061	368	*Hydræ*	59.3	26 5	4	3.55	3.6	6 5 86	3.5	5 23 87	3.8	6 8 87	3.45
2062	215	*Virginis*	59.7	8 18	4	6.7	6.8	7 13 82	6.7	6 5 86	6.7	6 3 88	6.6
2063	216	"	13 59.9	13 36	4	6.85	6.8	6 21 82	6.9	6 5 86	6.9	5 14 87	6.85
2064	217	"	14 0.1	8 43	2	6.1	6.0	7 13 82	6.1	6 5 86	6.1	.. .. ..	...
2065	...	"	1.8	11 14	4	6.95	...	6 5 86	6.9	5 14 87	6.9	5 18 89	6.9
2066	218	"	2.4	9 45	4	6.9	6.9	7 13 82	6.9	6 5 86	6.7	5 23 87	6.95
2067	219	"	4.0	15 43	5	5.55	5.6	6 21 82	5.3	6 5 86	5.6	6 20 86	5.6
2068	369	*Hydræ*	5.3	23 46	4	6.85	6.7	5 17 84	6.9	6 5 86	6.7	5 23 87	6.9
2069	370	"	5.6	26 40	3	5.5	5.5	5 17 84	5.5	6 5 86	5.5	6 4 88	5.5
2070	371	"	6.1	26 2	3	6.7	6.8	5 17 84	6.75	6 5 86	6.7	6 4 88	6.7
2071	223	*Virginis*	6.2	9 42	4	4.6	4.2	6 21 82	4.5	6 5 86	4.6	5 23 87	4.7
2072	224	"	7.2	0 15	4	6.25	6.2	7 12 82	6.1	6 20 86	6.35	6 30 86	6.3
2073	372	*Hydræ*	7.8	28 42	4	6.3	6.4	5 17 84	6.3	6 5 86	6.2	6 4 88	6.45
2074	225	*Virginis*	7.9	5 22	3	6.75	6.7	7 12 82	6.8	6 5 86	6.7	6 4 88	6.8
2075	226	"	8.5	17 37	4	5.9	5.8	6 21 82	5.9	6 5 86	5.9	6 4 88	5.9
2076	228	"	9.5	5 24	3	4.2	4.1	6 21 82	4.2	6 5 86	4.2	6 8 88	4.2
2077	229	"	9.8	6 2	4	6.7	6.8	7 12 82	6.8	6 5 86	6.7	6 4 88	6.65
2078	230	"	10.0	2 37	9	6.4	6.5	7 12 82	6.1	6 5 86	6.6	6 30 86	6.5
2079	231	"	10.2	18 0	3	6.75	6.7	6 21 82	6.8	6 5 86	6.7	6 4 88	6.8
2080	232	"	10.3	5 4	5	6.9	6.9	7 12 82	6.8	6 5 86	6.8	6 4 88	6.95
2081	...	"	10.6	5 10	3	7.15	7.2	7 12 82	7.2	6 5 86	7.1	6 4 88	7.15
2082	233	"	10.2	8 18	3	6.8	6.7	7 12 82	6.8	6 5 86	6.8	6 4 88	6.8
2083	234	"	10.7	8 27	3	6.8	6.8	7 12 82	6.8	6 5 86	6.8	6 4 88	6.8
2084	235	"	11.4	6 57	3	6.75	6.8	7 12 82	6.7	6 5 86	6.7	6 4 88	6.8
2085	236	"	11.7	18 8	4	6.2	6.2	6 21 82	6.2	6 5 86	6.3	6 4 88	6.2
2086	373	*Hydræ*	11.9	26 34	4	7.0	7.0	5 17 84	6.9	5 25 84	7.0	6 5 86	7.0
2087	374	"	11.9	25 15	4	6.2	6.3	5 17 84	6.1	6 5 86	6.2	6 30 86	6.3
2088	237	*Virginis*	12.4	12 48	3	4.8	5.0	6 21 82	4.8	6 5 86	4.8	6 8 88	4.75
2089	238	"	13.1	1 41	5	5.75	5.6	7 12 82	5.8	6 5 86	5.7	6 30 86	5.8
2090	239	"	13.3	+ 0 58	7	6.4	6.5	7 12 82	6.4	6 5 86	6.2	6 20 86	6.4
2091	240	"	13.3	− 6 10	3	6.75	6.6	7 12 82	6.8	6 5 86	6.8	6 4 88	6.7
2092	241	"	15.5	1 25	5	6.9	6.9	7 12 82	6.9	6 30 86	6.8	5 6 88	7.0
2093	375	*Hydræ*	15.9	27 11	6	5.15	5.0	5 17 84	5.05	6 5 86	5.5	6 30 86	5.1
2094	...	*Virginis*	16.0	7 12	3	6.95	7.0	7 12 82	7.0	6 5 86	6.9	6 4 88	6.95
2095	242	"	16.4	0 4	4	6.85	6.8	7 12 82	6.7	6 5 86	7.0	6 30 86	6.8
2096	376	*Hydræ*	16.6	29 6	4	7.0	7.0	5 17 84	7.0	5 25 84	6.9	6 5 86	7.0
2097	1	*Libræ*	16.7	11 9	4	6.6	6.5	7 12 82	6.6	6 26 86	6.7	6 10 87	6.55
2098	243	*Virginis*	16.9	+ 1 50	5	6.7	6.5	7 12 82	6.6	6 5 86	6.9	6 30 86	6.7
2099	...	*Libræ*	17.0	− 12 25	4	6.9	7.0	7 7 82	7.0	6 26 86	6.8	6 10 87	6.9
2100	2	"	17.1	15 32	4	6.7	6.8	7 7 82	6.8	6 26 86	6.7	6 4 88	6.65
2101	3	"	17.7	24 14	6	5.65	5.7	5 17 84	5.8	6 5 86	5.5	6 30 86	5.7
2102	4	"	18.0	11 6	4	6.7	6.6	7 7 82	6.6	6 26 86	6.8	6 10 87	6.7
2103	377	*Hydræ*	18.2	28 20	4	7.0	7.0	5 17 84	7.0	5 25 84	6.9	6 5 86	7.0
2104	5	*Libræ*	18.5	19 24	3	6.45	6.5	6 21 82	6.4	6 5 86	6.5	6 4 88	6.4
2105	6	"	18.5	12 47	4	6.8	6.7	7 7 82	6.8	6 26 86	6.8	6 10 87	6.75
2106	378	*Hydræ*	18.6	26 17	4	6.95	7.0	5 17 84	6.9	5 25 84	6.9	6 5 86	7.0
2107	379	"	20.9	28 56	7	4.85	4.8	5 17 84	4.6	6 5 86	4.65	6 30 86	4.7
2108	245	*Virginis*	20.9	5 33	5	6.4	6.5	7 12 82	6.4	6 5 86	6.4	6 4 88	6.35
2109	7	*Libræ*	21.0	12 48	4	6.7	6.8	7 7 82	6.7	6 26 86	6.7	6 10 87	6.7
2110	246	*Virginis*	13 21.8	1 40	9	5.3	5.4	7 12 82	5.6	6 5 86	5.25	6 20 86	5.35

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2111	8	*Libræ*	14 21.9	− 9 27	4	6.9	6.8	7 7 82	6.9	6 26 86	6.9	6 10 87	6.85
2112	247	*Virginis*	22.1	6 20	5	6.0	5.9	7 12 82	5.9	6 5 86	6.0	6 4 88	6.05
2113	249	"	22.3	4 40	5	6.7	6.9	7 12 82	6.8	6 5 86	6.75	6 4 88	6.65
2114	250	"	23.5	+ 1 23	5	6.25	6.4	7 12 82	6.1	6 5 86	6.3	6 30 86	6.3
2115	251	"	23.5	− 3 41	5	6.95	6.9	7 12 82	7.0	6 5 86	7.0	6 4 88	6.95
2116	...	"	24.0	3 30	5	7.2	7.1	7 12 82	7.2	6 5 86	7.2	6 4 88	7.2
2117	9	*Libræ*	27.8	19 53	3	6.6	6.8	7 7 82	6.6	6 5 86	6.5	6 8 88	6.7
2118	10	"	30.4	11 47	3	6.6	6.6	7 12 82	6.7	6 26 86	6.55	6 8 88	6.6
2119	11	"	32.3	10 1	3	6.95	6.9	7 12 82	7.0	6 26 86	6.9	6 8 88	6.9
2120	380	*Hydræ*	32.4	26 11	6	7.05	6.9	6 21 82	6.8	5 25 84	7.2	6 20 86	7.1
2121	381	"	33.2	25 43	5	6.9	6.9	6 21 82	6.8	5 25 84	7.0	6 4 86	6.85
2122	...	*Libræ*	35.3	11 42	2	6.9	7.0	7 12 82	6.9	6 26 86	6.9	.. .. ..	...
2123	12	"	36.0	24 28	6	5.9	5.8	6 21 82	5.8	6 4 86	5.9	6 30 86	5.9
2124	255	*Virginis*	36.5	5 7	5	4.0	4.0	7 12 82	4.2	6 5 86	3.9	5 23 87	4.0
2125	13	*Libræ*	36.7	9 10	3	6.85	6.8	7 12 82	6.8	6 26 86	6.9	6 8 88	6.85
2126	256	*Virginis*	37.6	7 44	3	6.9	6.8	7 12 82	6.9	5 23 87	6.95	6 8 88	6.9
2127	14	*Libræ*	38.1	9 10	3	6.95	7.0	7 12 82	6.9	6 26 86	6.9	6 8 88	7.0
2128	382-3	*Hydræ*	38.8	24 55	3	5.2	5.2	6 21 82	5.2	6 4 86	5.2	6 2 88	5.2
2129	257	*Virginis*	38.8	0 53	3	6.35	6.4	7 12 82	6.3	6 30 86	6.4	6 4 88	6.35
2130	15	*Libræ*	38.9	22 37	8	6.25	6.1	7 7 82	6.15	6 4 86	6.5	6 30 86	6.3
2131	16	"	39.1	14 56	6	6.7	6.6	7 7 82	6.5	6 26 86	6.8	6 10 87	6.7
2132	17	"	39.1	20 39	5	6.6	6.8	7 7 82	6.5	7 16 84	6.5	6 26 86	6.6
2133	258	*Virginis*	39.1	+ 1 15	3	5.9	6.0	7 12 82	5.9	6 30 86	5.85	6 4 88	6.0
2134	259	"	39.9	2 35	2	3.9	4.0	7 12 82	3.9	6 8 87	3.9	.. .. ..	...
2135	384	*Hydræ*	40.1	−25 6	3	6.0	6.1	6 21 82	6.0	6 4 86	6.0	6 2 88	6.0
2136	18	*Libræ*	40.1	20 48	10	6.55	6.4	7 7 82	6.4	7 16 84	6.4	6 26 86	6.8
2137	385	*Hydræ*	40.5	25 34	3	5.55	5.5	6 21 82	5.5	6 4 86	5.6	6 2 88	5.55
2138	386	"	40.7	26 7	5	6.05	6.3	6 21 82	6.1	6 18 84	6.1	6 4 86	6.0
2139	...	*Virginis*	40.8	+ 1 28	3	6.7	...	5 23 87	6.7	6 8 87	6.65	6 4 88	6.7
2140	19	*Libræ*	41.1	−12 19	4	6.7	6.6	7 7 82	6.8	6 26 86	6.7	6 11 88	6.65
2141	20	"	41.6	16 49	3	6.95	7.0	7 7 82	6.9	6 26 86	6.9	6 4 88	7.0
2142	21	"	42.1	23 44	6	6.15	6.3	7 7 82	6.0	6 4 86	6.3	6 30 86	6.15
2143	22	"	42.5	13 38	6	5.5	5.7	7 7 82	5.6	6 26 86	5.35	6 10 87	5.55
2144	23	"	42.5	0 20	5	6.2	6.3	7 12 82	6.3	6 30 86	6.25	6 4 88	6.2
2145	24	"	42.8	7 59	3	7.0	7.0	7 12 82	7.0	6 10 87	6.95	6 8 88	7.0
2146	387	*Hydræ*	43.0	27 26	4	4.7	4.8	6 21 82	4.7	6 4 86	4.8	6 2 88	4.8
2147	25	*Libræ*	43.8	15 29	4	6.4	6¼	7 7 82	6.6	6 10 87	6.6	6 4 88	6.25
2148	26	"	44.0	15 31	2	2.8	3	6 8 88	2.8	7 3 88	2.8	.. .. ..	...
2149	27	"	44.5	1 47	3	5.4	5.3	7 12 82	5.4	6 30 86	5.4	6 4 88	5.4
2150	28	"	44.6	17 16	3	6.6	6.6	7 7 82	6.6	6 26 86	6.7	6 4 88	6.5
2151	261	*Virginis*	44.6	+ 0 16	7	6.5	6.3	7 12 82	6.6	6 30 86	6.4	5 23 87	6.7
2152	29	*Libræ*	44.9	−17 50	4	6.55	6.5	7 7 82	6.6	6 26 86	6.7	6 4 88	6.45
2153	388	*Hydræ*	46.4	27 53	5	7.3	7.0	6 21 82	7.3	6 4 86	7.3	5 14 87	7.35
2154	389	"	47.0	27 50	3	6.8	6.9	6 21 82	6.8	6 4 86	6.85	6 2 88	6.8
2155	30	*Libræ*	47.1	24 8	5	5.75	5.8	7 7 82	5.75	6 4 86	5.7	6 30 86	5.7
2156	31	"	47.6	11 23	4	6.1	6.1	7 7 82	6.1	6 26 86	6.1	6 11 88	6.2
2157	390	*Hydræ*	49.6	25 47	4	6.85	7.0	6 21 82	6.8	6 4 86	6.85	6 8 88	6.9
2158	391	"	49.8	28 39	5	6.45	6.5	6 21 82	6.6	6 4 86	6.5	6 2 88	6.35
2159	32	*Libræ*	50.0	10 54	4	5.95	5.7	7 7 82	5.9	6 26 86	6.1	6 10 87	5.95
2160	33	"	50.2	20 51	4	6.1	6.1	7 7 82	6.1	6 26 86	5.95	6 10 87	6.2
2161	34	"	50.7	3 50	2	4.7	4.8	7 12 82	4.7	6 30 86	4.7	.. .. ..	...
2162	35	"	51.1	16 52	3	6.95	6.9	7 7 82	6.9	6 26 86	6.9	6 4 88	7.0
2163	264	*Virginis*	14 51.1	+ 0 20	3	6.0	6.0	7 12 82	6.0	6 30 86	6.0	6 4 88	6.05

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2164	392	*Hydræ*	14 51.3	−27 9	4	6.0	5.9	6 21 82	6.1	6 18 84	6.1	6 4 86	5.9
2165	. . .	*Libræ*	51.5	10 39	4	7.0	7.2	7 7 82	7.1	6 26 86	6.9	6 10 87	7.15
2166	36	"	52.2	10 38	4	6.45	6.3	7 7 82	6.3	6 26 86	6.5	6 10 87	6.45
2167	37	"	52.4	4 29	4	6.2	6.5	7 12 82	6.2	6 30 86	6.2	6 10 87	6.1
2168	38	"	54.3	8 1	3	var.	var.	7 12 82	5.2	6 21 86	5.7	6 30 86	5.1
2169	393	*Hydræ*	54.7	27 34	3	6.2	6.2	6 21 82	6.2	6 18 84	6.2	6 4 86	6.2
2170	39	*Libræ*	54.8	2 16	5	6.2	5.9	7 12 82	6.0	6 30 86	6.25	6 10 87	6.3
2171	40	"	55.1	2 40	2	6.85	6.9	7 12 82	6.85	6 30 86	6.85	.. .. ..	. . .
2172	41	"	55.4	7 51	3	7.1	7.0	7 12 82	7.1	6 30 86	7.1	6 8 88	7.1
2173	267	*Virginis*	55.4	+ 0 21	3	6.15	6.1	7 12 82	6.2	6 30 86	6.15	6 4 88	6.15
2174	42	*Libræ*	55.5	− 7 5	3	6.6	6.6	7 12 82	6.6	6 30 86	6.7	6 8 88	6.55
2175	43	"	55.9	7 21	3	6.75	6.8	7 12 82	6.7	6 30 86	6.85	6 10 87	6.75
2176	44	"	56.3	2 32	3	6.7	6.8	7 12 82	6.8	6 30 86	6.65	6 10 87	6.7
2177	268	*Virginis*	56.6	+ 2 35	3	4.9	4.9	7 12 82	4.95	5 23 87	5.0	6 8 88	4.8
2178	45	*Libræ*	56.8	−24 47	6	3.8	3.5	6 16 84	4.2	6 5 86	3.6	5 23 87	3.75
2179	46	"	58.5	25 18	3	6.8	7.0	7 7 82	6.8	6 26 86	6.8	6 9 88	6.8
2180	. . .	"	58.9	23 39	4	7.05	7.2	7 7 82	7.0	6 26 86	7.05	6 9 88	7.1
2181	47	"	59.2	21 33	5	6.55	6.5	7 7 82	6.7	6 26 86	6.4	6 10 87	6.6
2182	48	"	59.7	15 46	4	5.6	5.5	7 7 82	5.4	6 26 86	5.7	6 10 87	5.65
2183	49	"	14 59.9	16 0	4	6.7	6.9	7 7 82	6.9	6 26 86	6.6	6 10 87	6.65
2184	. . .	"	**15** 0.0	23 43	3	7.3	7.2	7 7 82	7.3	6 26 86	7.2	6 9 88	7.35
2185	50	"	2.6	23 30	3	6.95	6.8	7 7 82	7.0	6 26 86	6.95	6 9 88	6.9
2186	51	"	2.9	25 51	4	6.15	6.1	7 7 82	6.2	6 11 85	6.1	6 9 88	6.05
2187	52	"	5.1	19 19	3	4.85	5.0	7 2 82	4.95	6 10 87	4.9	7 3 88	4.7
2188	53	"	5.1	18 38	4	6.9	6.7	7 2 82	6.9	6 18 84	6.9	6 20 86	6.9
2189	54	"	5.4	17 37	3	6.95	7.0	7 2 82	7.0	6 20 86	6.9	6 4 88	6.95
2190	55	"	6.0	23 32	3	6.7	6.6	7 7 82	6.7	6 26 86	6.7	6 9 88	6.65
2191	56	"	6.2	24 50	4	6.8	6.8	7 7 82	6.7	6 26 86	6.8	6 9 88	6.8
2192	57	"	6.2	19 11	4	6.45	6.5	7 2 82	6.4	6 10 87	6.5	6 9 88	6.5
2193	58	"	6.5	10 32	3	6.85	7.0	5 24 84	6.8	6 21 86	6.9	6 9 88	6.85
2194	59	"	6.5	25 43	7	6.25	6.2	7 7 82	6.5	6 11 85	6.2	6 20 86	6.15
2195	60	"	7.4	17 58	4	6.8	6.7	7 2 82	6.9	6 18 84	6.7	6 20 86	6.9
2196	61	"	7.6	17 18	3	6.45	6.5	7 2 82	6.5	6 20 86	6.4	6 4 88	6.45
2197	1	***Serpentis Cap.***	7.6	0 52	5	6.7	6.7	5 26 84	6.6	6 10 87	6.65	6 26 87	6.7
2198	62	*Libræ*	8.2	27 8	3	6.85	6.9	7 7 82	6.9	6 26 86	6.8	6 9 88	6.9
2199	63	"	8.3	5 2	4	6.75	6.8	5 26 84	6.6	6 26 86	6.8	6 10 87	6.85
2200	64	"	9.2	21 56	3	5.9	5.8	7 7 82	5.8	6 26 86	5.95	6 10 87	5.9
2201	3	***Serpentis Cap.***	9.5	+ 0 50	4	6.0	6.0	5 26 84	6.0	6 10 87	6.1	6 26 87	5.9
2202	78	*Lupi*	10.2	−29 41	3	4.55	4.7	7 3 82	4.6	6 19 90	4.5	6 20 90	4.6
2203	65	*Libræ*	10.3	8 55	4	2.8	3.1	7 6 82	2.7	7 16 84	2.7	6 30 86	3.05
2204	6	*Serpentis Cap.*	12.0	0 0	5	6.45	6.4	5 26 84	6.3	6 10 87	6.45	6 26 87	6.45
2205	8	" "	12.5	1 8	4	6.9	6.9	5 26 84	6.9	6 10 87	6.85	6 26 87	6.9
2206	66	*Libræ*	13.0	27 50	4	6.95	7.0	7 7 82	6.9	6 26 86	7.05	6 10 87	7.0
2207	67	"	13.3	25 32	4	7.05	7.0	7 7 82	7.1	6 26 86	7.05	6 10 87	7.0
2208	68	"	13.8	17 42	5	6.6	6.6	7 2 82	6.7	6 18 84	6.6	6 20 86	6.5
2209	69	"	14.0	4 40	3	6.9	7.0	5 26 84	7.0	6 26 86	6.85	6 10 87	6.9
2210	70	"	14.0	15 6	4	6.25	6.4	5 24 84	6.4	6 26 86	6.3	6 4 88	6.15
2211	71	"	14.5	5 22	4	6.1	6.1	6 21 86	6.2	6 10 87	6.1	6 27 87	6.1
2212	10	*Serpentis Cap.*	14.4	1 57	4	6.65	6.7	5 26 84	6.6	6 10 87	6.65	6 26 87	6.7
2213	72	*Libræ*	15.2	28 54	3	6.7	6.6	7 7 82	6.7	6 26 86	6.7	6 9 88	6.75
2214	73	"	15.5	26 14	4	6.85	6.7	7 7 82	6.9	6 26 86	6.8	6 9 88	6.75
2215	74	"	16.1	14 41	3	7.0	7.0	5 24 84	6.9	6 26 86	7.0	6 4 88	7.05
2216	75	"	15 17.0	11 55	4	6.3	6.2	5 24 84	6.3	6 21 86	6.4	6 9 88	6.1

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2217	12	*Serpentis Cap.*	15 17.3	– 0 35	4	6.4	6.4	5 26 84	6.3	6 10 87	6.45	6 26 87	6.45
2218	76	*Libræ*	17.4	9 52	2	5.6	5.5	5 24 84	5.6	6 21 86	5.6	.. .. ..	...
2219	77	"	21.2	16 17	6	6.05	5.9	7 2 82	5.9	6 20 86	6.15	6 26 86	6.0
2220	78	"	21.4	8 54	3	6.95	6.9	5 24 84	7.0	6 21 86	6.9	6 9 88	6.95
2221	79	"	21.4	28 26	5	6.65	6.8	7 7 82	6.7	6 26 86	6.5	6 10 87	6.8
2222	80	"	22.5	17 1	5	6.9	7.0	7 2 82	6.9	6 18 84	6.8	6 20 86	6.9
2223	81	"	23.4	20 18	3	6.5	6.5	7 2 82	6.5	6 20 86	6.5	6 4 88	6.5
2224	82	"	23.6	16 11	6	6.15	6.0	7 2 82	6.1	6 20 86	6.15	6 26 86	6.0
2225	83	"	24.6	19 44	3	6.6	6.7	7 2 82	6.6	6 20 86	6.5	6 4 88	6.7
2226	84	"	25.4	19 15	4	5.95	6.2	7 2 82	6.0	6 20 86	6.0	6 4 88	5.95
2227	85	"	25.5	10 1	4	7.0	7.0	5 24 84	7.1	6 21 86	6.9	6 10 87	7.05
2228	86	"	25.8	24 4	4	6.6	6.7	7 2 82	6.6	6 20 86	6.55	6 4 88	6.55
2229	87	"	25.9	16 26	5	5.7	5.8	7 2 82	5.6	6 20 86	5.7	6 26 86	5.6
2230	15	*Serpentis Cap.*	26.5	0 46	3	6.05	5.9	5 26 84	6.0	6 10 87	6.1	6 26 87	6.0
2231	88	*Libræ*	27.1	27 38	4	6.0	5.7	6 11 85	5.7	6 10 87	6.05	6 27 87	6.2
2232	89	"	27.3	9 38	3	5.25	5.5	5 24 84	5.3	6 21 86	5.3	7 3 88	5.2
2233	90	"	27.7	8 46	5	5.65	5.6	5 24 84	5.7	6 21 86	5.5	6 10 87	5.8
2234	91	"	27.8	5 16	5	6.85	6.7	5 26 84	7.0	6 26 86	6.85	6 10 87	6.75
2235	92	"	28.5	14 22	5	4.5	4.4	6 26 86	4.6	6 10 87	4.6	6 9 88	4.4
2236	93	"	29.4	27 43	5	4.1	3 9	6 13 82	4.3	6 4 86	4.1	6 5 86	3.95
2237	94	"	30.0	25 52	5	6.45	6.6	6 11 85	6.4	6 10 87	6.65	6 27 87	6.35
2238	95	"	30.2	21 42	5	7.2	6.9	7 2 82	7.25	6 20 86	7.2	6 10 87	7.3
2239	19	*Serpentis Cap*	30.2	0 9	4	6.85	6.8	5 26 84	6.9	6 10 87	6.85	6 26 87	6.8
2240	96	*Libræ*	30.5	22 44	4	6.4	6.1	7 2 82	6.3	6 20 86	6.5	5 23 87	6.4
2241	97	"	30.7	27 48	4	6.7	6.5	6 11 85	6.75	6 26 86	6.6	6 10 87	6.85
2242	98	"	31.0	29 22	5	3.85	3.8	6 13 82	3.9	6 4 86	3.9	6 5 86	3.8
2243	99	"	31.0	20 36	5	6.5	6.4	7 2 82	6.3	6 20 86	6.6	6 10 87	6.6
2244	100	"	31.3	19 30	3	7.0	7.0	7 2 82	7.0	6 20 86	7.05	6 4 88	6.95
2245	...	"	31.5	14 6	3	7.05	7.1	5 24 84	7.0	6 26 86	7.1	6 9 88	7.05
2246	101	"	31.7	18 53	4	6.1	5.9	7 2 82	6.1	6 20 86	6.15	6 4 88	6.2
2247	102-3	"	31.9	8 23	4	6.25	6.2	5 24 84	6.2	6 21 86	6.4	6 10 87	6.25
2248	104	"	32.0	22 44	5	6.7	6.9	7 2 82	6.8	6 20 86	6.8	6 4 88	6.7
2249	105	"	32.9	23 25	3	5.65	5.7	7 2 82	5.7	6 20 86	5.6	6 4 88	5.65
2250	...	"	34.3	13 34	3	6.95	...	5 24 84	6.9	6 26 86	7.0	7 18 90	7.0
2251	106	"	34.8	19 16	5	5.5	5.5	7 2 82	5.35	6 20 86	5.55	6 12 87	5.5
2252	107	"	36.2	12 39	6	6.85	6.8	5 24 84	6.7	6 26 86	7.0	6 12 87	6.7
2253	108	"	36.4	14 38	2	6.6	6.6	5 24 84	6.6	6 26 86	6.6	.. .. ..	...
2254	109	"	37.1	15 16	5	5.8	5.9	5 24 84	6.0	6 26 86	5.85	6 12 87	5.75
2255	110	"	38.6	27 40	3	6.65	6.7	6 11 85	6.7	6 12 87	6.6	6 27 87	6.65
2256	24	*Serpentis Cap.*	39.6	1 25	4	5.8	5.8	5 26 84	5.9	6 10 87	5.7	9 8 87	5.9
2257	111	*Libræ*	40.1	5 44	3	6.75	6.7	6 17 84	6.8	6 26 86	6.7	6 9 88	6.7
2258	1	*Scorpii*	41.0	23 27	6	7.05	6.9	7 2 82	7.1	6 18 84	7.0	6 6 86	6.9
2259	112	*Libræ*	42.4	3 26	3	6.1	6.1	5 26 84	6.0	6 10 87	6.2	6 27 87	6.1
2260	27	*Serpentis Cap.*	43.1	3 9	4	3.3	3.3	7 6 82	3.3	7 16 84	3.3	6 30 86	3.2
2261	2	*Scorpii*	43.5	25 22	5	5.3	5.3	7 2 82	5.3	6 6 86	5.3	6 26 86	5.3
2262	133	*Lupi*	44.5	29 30	3	6.9	6.8	7 3 88	6.9	7 6 88	6.9	6 18 90	6.85
2263	113	*Libræ*	44.7	13 45	3	6.65	6.5	5 24 84	6.6	6 26 86	6.6	6 11 88	6.7
2264	30	*Serpentis Cap.*	44.8	2 43	2	5.6	5.7	5 26 84	5.6	6 10 87	5.6	.. .. ..	...
2265	114	*Libræ*	46 1	19 48	3	5.6	5.5	7 2 82	5.7	6 26 86	5.5	6 12 87	5.55
2266	3.	*Scorpii*	46.1	24 57	5	5.05	5.2	7 2 82	5.0	6 6 86	5.1	6 26 86	5.05
2267	4	"	46.4	24 10	5	5.95	5.8	7 2 82	5.9	6 6 86	5.95	6 26 86	6.0
2268	5	"	46.5	23 36	4	5.95	5.8	7 2 82	5.9	6 6 86	5.95	6 26 86	6.0
2269	115	*Libræ*	15 46.7	16 22	3	4.85	4.8	7 6 82	4.85	6 26 86	4.8	6 9 88	4.9

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1897.

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Date.	Mag.	Date.	Mag.	Date	Mag.
			h. m.	° ′									
2270	6	*Scorpii*	15 46.9	−26 58	6	6.75	6.9	7 2 82	6.8	6 18 84	6.8	7 16 84	7.0
2271	7	"	47.2	24 52	8	6.6	6.7	7 2 82	6.55	6 18 84	6.6	6 6 86	6.8
2272	116	*Libræ*	47.8	19 1	6	6.4	6.4	6 26 86	6.4	6 12 87	6.2	6 27 87	6.4
2273	8	*Scorpii*	48.0	25 54	6	6.35	6.3	7 2 82	6.4	6 18 84	6.4	6 6 86	6.2
2274	9	"	49.2	28 51	4	4.45	4.5	6 13 82	4.6	6 4 86	4.4	5 25 87	4.4
2275	117	*Libræ*	49.2	14 2	5	6.6	6.6	7 6 82	6.7	5 24 84	6.6	6 26 86	6.6
2276	33	*Serpentis Cap.*	49.4	1 48	2	7.0	6.9	6 17 84	7.0	6 12 87	7.0	.. .. ..	...
2277	118	*Libræ*	49.5	14 28	6	6.45	6.5	7 6 82	6.6	5 24 84	6.4	6 26 86	6.45
2278	10	*Scorpii*	50.4	20 37	2	6.4	6.4	7 6 82	6.4	5 25 87	6.4	.. .. ..	...
2279	11	"	51.1	24 28	7	6.05	6.1	7 2 82	6.2	6 6 86	6.1	6 26 86	6.0
2280	119	*Libræ*	51.2	13 55	4	5.2	5.4	7 6 82	5.1	6 26 86	5.25	6 28 86	5.2
2281	12	*Scorpii*	51.3	25 45	8	3.1	3.4	6 13 82	3.4	6 16 84	2.95	6 18 84	3.1
2282	13	"	53.0	22 16	6	2.4	2.4	6 13 82	2.3	6 16 84	2.3	6 18 84	2.3
2283	120	*Libræ*	53.0	6 57	2	6.8	6.9	6 17 84	6.8	6 12 87	6.8	.. .. ..	...
2284	121	"	53.3	16 10	5	6.0	5.9	7 6 82	5.8	6 26 86	6.0	6 12 87	6.0
2285	122	"	54.1	8 3	5	6.0	6.0	6 17 84	6.3	6 26 86	6.0	6 12 87	5.8
2286	14	*Scorpii*	54.9	28 47	3	6.7	6.7	7 3 82	6.6	6 26 86	6.7	6 9 88	6.75
2287	1	*Ophiuchi*	55.2	3 25	6	7.05	7.0	6 17 84	7.0	6 28 86	7.1	6 12 87	7.0
2288	15	*Scorpii*	55.8	25 31	6	5.8	5.7	7 2 82	5.6	6 6 86	5.95	6 26 86	5.9
2289	16	"	56.4	24 23	5	6.85	6.8	7 6 82	6.7	6 6 86	6.8	6 26 86	6.9
2290	17	"	57.5	11 2	4	4.6	4.6	7 6 82	4.75	6 28 86	4.4	6 12 87	4.6
2291	18	"	58.2	19 28	4	2.6	2.5	6 13 82	2.6	6 16 84	2.6	6 18 84	2.6
2292	37	*Serpentis Cap.*	58.6	3 11	6	7.05	6.9	6 17 84	7.0	6 28 86	7.2	6 12 87	7.0
2293	19	*Scorpii*	58.7	23 16	7	6.35	6.2	7 6 82	6.2	6 26 86	6.35	6 12 87	6.3
2294	2	*Ophiuchi*	59.1	5 57	5	6.75	6.8	6 17 84	6.8	6 28 86	6.6	6 12 87	6.7
2295	3	"	59.4	5 48	4	6.85	6.9	6 17 84	6.8	6 28 86	6.75	6 12 87	6.9
2296	20	*Scorpii*	15 59.5	20 20	5	4.4	4.4	6 13 82	4.3	6 16 84	4.2	6 18 84	4.5
2297	21	"	16 0.1	20 32	8	4.55	4.6	6 13 82	4.3	6 16 84	4.3	6 18 84	4.5
2298	22	"	0.1	13 44	5	6.65	6.8	7 6 82	6.7	7 16 84	6.7	6 28 86	6.7
2299	24	"	0.4	24 8	4	6.7	6.7	7 6 82	6.7	6 26 86	6.65	6 14 87	6.7
2300	25	"	0.5	25 59	7	6.2	6.0	7 3 82	5.9	6 26 86	6.3	6 10 87	6.25
2301	26	"	0.7	12 24	4	6.1	6.0	7 6 82	6.1	6 28 86	6.2	6 12 87	6.05
2302	27	"	1.3	23 21	5	6.25	6.3	7 6 82	6.3	6 26 86	6.25	6 14 87	6.3
2303	29	"	1.6	9 46	4	6.9	7.0	7 6 82	6.9	6 28 86	6.9	6 30 89	6.8
2304	31	"	2.6	26 35	3	6.8	6.9	7 3 82	6.9	6 26 86	6.8	6 9 88	6.75
2305	32	"	2.7	24 15	4	6.9	6.9	7 6 82	6.9	6 26 86	6.9	6 14 87	6.85
2306	33	"	2.7	18 0	3	6.85	6.9	7 6 82	6.8	6 26 86	6.9	6 9 88	6.85
2307	35	"	3.3	29 5	3	5.8	5.8	7 3 82	5.7	6 26 86	5.8	6 9 88	5.85
2308	43	*Serpentis Cap.*	3.3	3 8	4	6.1	5.9	6 17 84	6.2	6 28 86	6.1	6 12 87	6.0
2309	36	*Scorpii*	4.6	28 5	7	6.1	6.1	7 3 82	6.3	6 26 86	6.1	6 12 87	6.0
2310	37	"	4.6	27 36	3	5.25	5.3	7 3 82	5.25	6 26 86	5.3	6 9 88	5.2
2311	38	"	4.7	19 8	5	4.1	4.3	6 13 82	3.9	6 16 84	4.05	6 18 84	4.2
2312	39	"	5.2	9 44	4	5.35	5.2	7 6 82	5.2	6 28 86	5.4	6 12 87	5.4
2313	40	"	5.4	8 13	3	5.75	5.7	7 6 82	5.7	6 28 86	5.8	6 9 88	5.7
2314	41	"	6.3	24 6	5	6.7	6.7	7 6 82	6.8	6 26 86	6.65	6 12 87	6.65
2315	42	"	6.3	21 5	3	7.05	7.0	7 6 82	7.0	6 26 86	7.0	6 9 88	7.15
2316	5	*Ophiuchi*	6.4	3 54	5	6.75	7.0	6 17 84	6.6	6 28 86	6.75	6 12 87	6.8
2317	44	*Scorpii*	6.9	11 31	4	5.7	5.6	7 6 82	5.5	6 28 86	5.8	6 12 87	5.7
2318	6	*Ophiuchi*	7.0	7 48	5	7.1	6.9	7 6 82	7.1	6 28 86	6.9	6 12 87	7.1
2319	45	*Scorpii*	7.1	20 47	3	6.85	6.9	7 6 82	6.9	6 26 86	6.8	6 9 88	6.85
2320	45	*Serpentis Cap.*	7.2	1 9	3	6.8	6.9	6 17 84	6.8	6 12 87	6.75	9 8 87	6.9
2321	46	*Scorpii*	7.3	25 10	4	6.4	6.4	7 6 82	6.3	6 26 86	6.35	6 14 87	6.45
2322	47	"	16 7.5	18 13	3	6.85	6.9	7 6 82	6.8	6 26 86	6.9	6 9 88	6.85

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag	Date.	Mag.	Date	Mag.
			h. m	° ′									
2323	7	*Ophiuchi*	16 7.8	− 3 22	3	2.95	2.7	7 6 82	2.9	7 16 84	2.9	6 30 86	3.0
2324	48	*Scorpii*	8.8	14 32	4	6.35	6.3	7 6 82	6.35	6 28 86	6.45	6 12 87	6.25
2325	49	"	8.8	8 1	3	5.9	5.7	7 6 82	5.8	6 28 86	5.9	6 9 88	6.0
2326	50	"	8.9	23 58	4	6.9	6.9	7 6 82	7.0	6 26 86	6.9	6 14 87	6.85
2327	51	"	9.6	20 59	3	6.95	7.0	7 6 82	7.0	6 26 86	6.95	6 9 88	6.85
2328	52	"	9.7	19 48	3	6.95	6.9	7 6 82	6.9	6 26 86	6.95	6 9 88	7.0
2329	47	*Serpentis Cap.*	9.9	1 20	4	7.15	7.0	6 17 84	7.1	6 12 87	7.2	9 8 87	7.1
2330	8	*Ophiuchi*	10.4	3 39	5	6.85	6.9	6 17 84	6.6	6 28 86	6.85	6 12 87	6.9
2331	53	*Scorpii*	10.6	28 18	3	5.45	5.5	7 3 82	5.4	6 26 86	5.45	6 9 88	5.45
2332	...	"	10.9	13 4	5	7.25	7.3	7 6 82	7.1	7 16 84	7.3	6 28 86	7.25
2333	...	"	11.0	13 8	5	7.3	7.3	7 6 82	7.1	7 16 84	7.3	6 28 86	7.25
2334	55	"	11.6	30 36	3	5.8	5.8	7 3 82	5.9	6 26 86	5.8	6 9 88	5.75
2335	9	*Ophiuchi*	11.7	4 23	3	3.1	3.3	7 6 82	3.1	7 16 84	3.1	6 30 86	3.1
2336	58	*Scorpii*	11.8	19 55	3	6.95	6.8	7 6 82	6.9	6 26 86	6.9	6 9 88	7.0
2337	57	"	12.0	14 34	3	6.6	6.4	7 6 82	6.6	6 28 86	6.7	6 9 88	6.55
2338	59	"	13.1	23 52	8	5.15	5.1	7 3 82	4.9	6 5 86	5.0	6 12 87	5.2
2339	60	"	13.5	12 37	2	6.7	6.7	7 6 82	6.7	6 28 86	6.7	.. .. ..	...
2340	61	"	13.6	25 17	6	3.55	3.4	6 13 82	3.4	6 16 84	3.6	6 18 84	3.7
2341	63	"	15.7	16 43	3	7.1	7.0	7 6 82	7.1	6 12 87	7.1	6 9 88	7.05
2342	10	*Ophiuchi*	16.2	1 47	4	6.65	6.6	6 17 84	6.6	6 30 86	6.75	6 12 87	6.7
2343	11	"	16.8	19 45	5	4.95	4.8	7 3 82	4.9	7 16 84	4.9	6 5 86	5.0
2344	67	*Scorpii*	16.8	29 25	5	5.9	5.9	7 3 82	6.1	6 26 86	5.8	6 12 87	5.9
2345	12–13	*Ophiuchi*	18.1	23 9	4	4.75	4.8	7 3 82	4.75	6 5 86	4.7	6 14 87	4.85
2346	14	"	18.2	2 12	5	7.1	7.0	6 17 84	7.1	6 30 86	7.0	6 13 87	7.2
2347	15	"	19.8	18 10	9	4.85	4.6	7 3 82	5.0	7 16 84	4.6	6 5 86	4.8
2348	17	"	21.0	7 19	4	5.9	5.7	7 13 82	5.9	6 28 86	6.05	6 30 86	5.85
2349	18	"	21.1	8 5	3	5.1	5.2	7 13 82	5.2	6 30 86	5.1	6 11 88	4.95
2350	20	"	22.1	7 51	4	6.75	6.6	7 13 82	6.8	6 28 86	6.65	6 30 86	6.8
2351	70	*Scorpii*	22.6	24 50	5	5.1	5.3	7 3 82	5.1	7 16 84	5.2	6 5 86	5.0
2352	22	*Ophiuchi*	22.7	14 17	3	5.9	6.1	7 6 82	5.9	6 28 86	6.0	6 11 88	5.85
2353	...	"	22.9	10 51	6	7.0	...	5 10 85	7.0	9 8 87	7.0	6 9 88	6.95
2354	73	*Scorpii*	23.7	26 16	2	6.65	6.5	7 6 82	6.65	6 26 86	6.65	.. .. ..	...
2355	23	*Ophiuchi*	23.8	7 14	5	6.7	6.9	7 13 82	6.8	6 28 86	6.55	6 30 86	6.7
2356	24	"	24.0	16 20	4	4.7	4.6	7 3 82	4.75	6 5 86	4.8	6 14 87	4.55
2357	26	"	24.7	21 12	4	4.7	4.7	7 3 82	4.75	6 5 86	4.7	6 14 87	4.6
2358	75	*Scorpii*	28.1	27 57	5	3.25	3.2	6 13 82	3.1	6 16 84	3.3	6 18 84	3.3
2359	...	*Ophiuchi*	29.7	8 36	6	6.95	...	5 10 85	7.0	6 13 87	6.9	9 8 87	6.95
2360	27	"	29.8	2 3	2	6.2	6.3	9 3 82	6.2	6 30 86	6.2	.. .. ..	...
2361	28	"	30.3	10 19	3	2.65	2.6	7 6 82	2.7	7 16 84	2.7	6 30 86	2.6
2362	29	"	31.2	17 58	3	6.95	7.0	7 6 82	6.95	6 28 86	6.95	6 11 88	7.0
2363	30	"	31.3	6 17	5	6.3	6.4	7 13 82	6.4	6 30 86	6.25	6 13 87	6.4
2364	31	"	32.0	8 22	5	6.95	6.9	7 13 82	6.8	6 28 86	7.0	6 13 87	7.0
2365	32	"	32.1	0 59	4	7.0	7.0	9 3 82	7.1	6 30 86	7.0	6 13 87	6.9
2366	34	"	32.2	20 10	4	6.6	6.8	7 6 82	6.7	6 28 86	6.55	6 13 87	6.6
2367	33	"	32.8	9 18	4	6.7	6.7	7 13 82	6.8	6 28 86	6.55	6 13 87	6.7
2368	35	"	33.4	5 50	4	6.9	6.8	7 13 82	6.9	6 30 86	6.95	9 8 87	6.85
2369	82	*Scorpii*	33.9	27 34	4	6.95	7.0	7 6 82	6.9	6 26 86	7.0	6 9 88	6.9
2370	36	*Ophiuchi*	34.0	24 13	4	6.3	6.3	7 6 82	6.15	6 13 87	6.4	9 10 87	6.4
2371	37	"	34.1	17 49	4	7.0	7.0	7 6 82	7.1	6 28 86	6.95	6 13 87	7.0
2372	38	"	34.2	8 4	3	6.95	6.9	7 13 82	6.9	6 28 86	7.0	6 9 88	6.95
2373	39	"	34.4	17 30	6	5.45	5.5	7 3 82	5.2	7 16 84	5.6	6 28 86	5.55
2374	40	"	34.6	19 41	3	5.9	6.0	7 6 82	5.9	6 28 86	5.95	6 11 88	5.9
2375	41	"	16 34.7	0 45	3	6.5	6.5	9 3 82	6.5	6 30 86	6.4	6 11 88	6.55

No.	U. A. No.	Name	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
2376	88	*Scorpii*	16 36.2	−26 34	4	6.95	6.9	7 6 82	6.9	6 26 86	7.0	6 9 88	6.9
2377	89	"	36.5	27 13	4	6.75	6.8	7 6 82	6.8	6 26 86	6.75	6 9 88	6.75
2378	90	"	37.2	28 17	4	6.4	6.4	7 6 82	6.4	6 26 86	6.3	6 9 88	6.45
2379	92	"	39.2	25 18	4	7.0	7.0	7 6 82	6.9	6 26 86	7.0	6 9 88	7.05
2380	46	*Ophiuchi*	41.4	14 41	3	6.25	6.1	7 19 82	6.3	6 28 86	6.2	6 11 88	6.2
2381	47	"	42.1	24 25	5	6.8	6.7	7 6 82	6.9	6 3 87	6.65	9 10 87	6.85
2382	48	"	42.3	15 27	3	6.3	6.5	7 19 82	6.3	6 28 86	6.3	6 11 88	6.3
2383	49	"	42.9	10 34	4	5.1	5.1	7 13 82	4.8	6 30 86	5.2	6 13 87	5.15
2384	50	"	43.7	16 20	3	6.85	6.9	7 19 82	6.8	6 28 86	6.9	6 11 88	6.9
2385	51	"	43.9	2 26	3	6.6	6.6	9 3 82	6.5	6 30 86	6.6	6 11 88	6.7
2386	53	"	45.6	2 35	3	6.9	7.0	9 3 82	6.85	6 30 86	6.9	6 11 88	6.9
2387	54	"	46.1	20 12	4	6.3	6.1	7 6 82	6.4	7 19 82	6.2	6 28 86	6.35
2388	55	"	46.7	+ 0 14	3	6.9	6.8	9 3 82	6.85	6 30 86	6.9	6 11 88	6.95
2389	56	"	47.6	− 1 24	3	6.55	6.5	9 3 82	6.6	6 30 86	6.6	6 11 88	6.5
2390	57	"	47.7	11 35	4	6.7	6.7	7 19 82	6.5	6 13 87	6.8	9 8 87	6.7
2391	58	"	47.9	5 57	3	5.7	5.8	7 19 82	5.8	6 30 86	5.7	6 13 87	5.6
2392	59	"	48.1	21 22	6	6.8	6.8	7 19 82	6.8	6 13 87	6.5	9 8 87	6.9
2393	60	"	48.8	16 36	3	6.65	6.5	7 19 82	6.6	6 28 86	6.7	6 11 88	6.65
2394	61	"	49.3	22 57	3	5.9	5.9	7 19 82	5.8	6 30 86	6.0	6 13 87	5.9
2395	62	"	49.7	19 20	4	6.55	6.5	7 19 82	6.4	6 28 86	6.55	6 13 87	6.6
2396	63	"	50.5	10 46	2	6.4	6.5	7 19 82	6.4	6 13 87	6.4	.. .. ..	...
2397	64	"	51.6	14 40	3	6.55	6.5	7 19 82	6.6	6 28 86	6.5	6 11 88	6.5
2398	66	"	52.3	24 54	3	6.35	6.3	7 19 82	6.4	6 30 86	6.3	6 11 88	6.35
2399	67	"	52.5	24 48	3	6.15	6.1	7 19 82	6.25	6 30 86	6.1	6 13 87	6.15
2400	68	"	52.5	18 3	4	6.8	6.7	7 19 82	6.9	6 28 86	6.85	6 13 87	6.75
2401	70	"	54.5	4 2	42	5.4	5.5	6 9 82	5.4	7 19 82	5.4	6 30 86	5.45
2402	71	"	54.6	18 42	3	6.8	6.8	7 19 82	6.8	6 28 86	6.85	6 11 88	6.8
2403	74	"	56.3	25 31	3	6.75	6.8	7 19 82	6.8	6 30 86	6.7	6 11 88	6.75
2404	73	"	56.6	28 24	3	6.85	6.7	7 19 82	6.8	6 30 86	6.9	6 11 88	6.9
2405	75	"	57.0	·25 28	3	6.7	6.7	7 19 82	6.65	6 30 86	6.65	6 11 88	6.75
2406	76	"	57.3	+ 0 2	2	6.8	6.8	7 20 82	6.8	6 30 86	6.8	.. .. ..	...
2407	77	"	57.4	−20 19	3	6.5	6.4	7 19 82	6.6	6 13 87	6.55	6 11 88	6.4
2408	78	"	58.0	21 54	4	7.0	7.0	7 19 82	7.1	6 13 87	6.9	9 8 87	7.15
2409	79	"	58.7	21 23	3	6.45	6.6	7 19 82	6.4	6 13 87	6.4	6 11 88	6.55
2410	81	"	58.9	+ 0 53	3	6.25	6.2	7 2 82	6.3	7 20 82	6.2	6 30 86	6.25
2411	82	"	59.1	− 0 43	4	5.95	5.9	7 2 82	5.85	7 20 82	6.0	6 30 86	5.9
2412	80	"	16 59.2	26 21	4	6.5	6.6	7 19 82	6.4	6 30 86	6.6	6 13 87	6.5
2413	84	"	17 0.4	0 29	4	6.5	6.6	7 2 82	6.5	7 20 82	6.5	6 30 86	6.45
2414	85	"	1.0	17 27	4	6.45	6.6	7 19 82	6.4	6 28 86	6.55	9 10 87	6.3
2415	86	"	1.8	0 55	5	6.2	6.3	7 2 82	6.2	7 20 82	6.2	6 30 86	6.25
2416	87	"	2.3	3 43	3	6.65	6.7	7 20 82	6.7	9 10 87	6.6	6 29 88	6.6
2417	88	"	2.9	10 21	3	5.75	5.8	7 20 82	5.7	9 10 87	5.75	7 6 88	5.75
2418	89	"	2.9	19 17	4	7.0	7.0	7 19 82	7.1	9 10 87	6.9	9 15 87	7.1
2419	90	"	3.2	15 34	4	2.55	2.4	7 6 82	2.6	7 16 84	2.6	6 30 86	2.4
2420	91	"	3.7	12 32	5	6.8	6.5	7 20 82	6.9	9 10 87	6.8	9 16 87	6.7
2421	92	"	3.9	+ 0 39	3	6.95	7.0	7 20 82	7.0	6 30 86	6.9	7 6 88	6.9
2422	93	"	4.4	−26 53	6	6.9	7.0	7 13 82	6.7	6 30 86	6.9	9 10 87	6.95
2423	94	"	4.6	25 6	4	6.65	6.6	7 13 82	6.7	6 30 86	6.65	9 10 87	6.6
2424	95	"	4.6	27 36	5	6.3	6.3	7 13 82	6.4	6 30 86	6.3	9 10 87	6.25
2425	98	"	6.2	27 39	6	6.9	7.0	7 13 82	6.7	6 30 86	6.9	9 10 87	6.95
2426	99	"	6.5	26 50	6	6.9	7.0	7 13 82	6.7	6 30 86	6.9	9 10 87	6.95
2427	100	"	6.5	15 25	3	6.85	6.8	7 19 82	6.85	6 28 86	6.8	9 24 88	6.9
2428	101	"	17 6.5	+ 0 31	3	6.85	6.8	7 2 82	6.8	7 20 82	6.9	6 30 86	6.9

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
2429	103–4	*Ophiuchi*	17 7.7	−26 25	3	4.9	4.9	7 13 82	4.8	6 30 86	5.0	9 10 87	4.9
2430	105	"	8.2	14 26	3	6.4	6.3	7 19 82	6.35	6 28 86	6.45	7 3 88	6.45
2431	106	"	8.6	26 22	5	6.95	6.8	6 30 86	6.9	9 10 87	7.0	6 11 88	6.9
2432	107	"	8.8	9 40	5	7.05	7.0	7 20 82	7.0	9 10 87	6.9	7 6 88	7.2
2433	...	"	9.9	26 29	4	7.0	...	9 10 87	7.1	6 11 88	6.9	9 27 88	7.0
2434	109	"	10.0	6 6	2	6.3	6.3	7 20 82	6.3	9 18 86	6.3	.. .. ..	...
2435	110	"	10.2	+ 1 21	..	var.	var.	7 2 82	6.1	.. .. ..	...	.. .. ..	...
2436	111	"	10.2	− 0 18	3	5.15	5.1	7 19 82	5.2	9 10 87	5.1	6 29 88	5.1
2437	112–3	"	10.4	24 9	3	5.55	5.5	7 13 82	5.5	6 30 86	5.6	7 6 88	5.55
2438	114	"	10.5	23 56	4	6.9	6.9	7 13 82	7.0	6 30 86	6.8	9 10 87	6.9
2439	115	"	11.1	16 11	4	6.9	7.0	7 19 82	6.85	6 28 86	7.05	9 10 87	6.85
2440	116	"	11.3	+ 1 53	5	6.95	6.9	7 2 82	7.0	9 10 87	6.95	7 6 88	6.9
2441	118	"	12.3	− 2 40	4	6.65	6.7	7 20 82	6.7	9 10 87	6.65	6 29 88	6.6
2442	119	"	12.6	17 37	3	6.2	6.1	7 19 82	6.1	9 10 87	6.3	9 15 87	6.2
2443	121	"	13.2	19 12	3	6.85	6.8	7 19 82	6.85	9 10 87	6.85	7 6 88	6.8
2444	122	"	13.3	5 47	4	6.6	6.5	7 20 82	6.5	9 18 86	6.7	9 10 87	6.5
2445	124	"	13.5	20 59	4	4.9	5.1	7 13 82	5.1	6 30 86	4.8	9 10 87	4.85
2446	1	*Serpentis Cau.*	13.8	12 43	4	4.45	4.6	7 19 82	4.5	6 30 86	4.4	9 30 86	4.4
2447	2	" "	13.9	10 34	3	6.55	6.6	7 20 82	6.6	6 30 86	6.5	6 29 88	6.55
2448	125	*Ophiuchi*	14.0	24 47	4	6.95	6.8	6 30 86	7.0	9 16 87	7.0	9 28 88	6.85
2449	126	"	14.3	24 52	5	3.75	3.6	7 13 82	3.9	9 10 87	3.9	9 16 87	3.6
2450	127	"	15.5	24 59	4	7.3	7.0	7 13 82	7.4	6 30 86	7.2	9 16 87	7.5
2451	128	"	15.5	28 1	4	5.85	5.8	7 13 82	5.8	9 16 87	5.7	7 6 88	5.95
2452	130	"	16.3	6 58	3	6.95	6.9	7 20 82	6.95	9 18 86	6.9	7 6 88	6.95
2453	131	"	16.3	2 16	4	6.5	6.5	7 20 82	6.4	9 16 87	6.5	6 29 88	6.6
2454	3	*Serpentis Cau.*	16.4	15 55	4	6.9	6.9	7 19 82	6.85	6 28 86	6.8	6 29 88	7.0
2455	132	*Ophiuchi*	17.2	21 19	5	6.3	6.4	7 13 82	6.2	9 12 86	6.3	6 30 86	6.3
2456	133	"	17.3	18 20	4	6.45	6.4	7 19 82	6.35	9 16 87	6.5	10 13 87	6.5
2457	...	"	17.5	24 8	3	6.95	...	9 16 87	7.0	9 27 88	7.0	9 28 89	6.8
2458	135	"	18.7	24 4	4	4.6	4.5	7 13 82	4.4	6 30 86	4.7	9 16 87	4.6
2459	136	"	19.2	25 50	4	6.5	6.5	7 13 82	6.5	6 30 86	6.45	7 6 88	6.65
2460	137	"	19.3	6 28	3	6.95	6.9	7 20 82	6.95	9 18 86	6.9	7 6 88	6.95
2461	138	"	19.5	1 33	3	6.7	6.5	7 20 82	6.7	9 16 87	6.65	6 29 88	6.7
2462	139	"	19.4	29 45	4	4.6	4.6	7 13 82	4.4	9 16 87	4.75	7 6 88	4.6
2463	140	"	19.7	29 37	6	6.5	6.7	7 13 82	7.0	9 16 87	6.55	10 13 87	6.3
2464	141	"	20.0	4 58	4	4.75	4.5	7 19 82	4.9	6 30 86	4.8	9 30 86	4.7
2465	4	*Serpentis Cau.*	20.0	15 45	4	6.95	7.0	7 19 82	7.1	6 28 86	6.8	9 10 87	6.95
2466	5	" "	20.0	12 24	5	6.5	6.5	7 20 82	6.4	6 30 86	6.4	9 16 87	6.55
2467	144	*Ophiuchi*	21.3	8 6	3	6.6	6.4	7 20 82	6.5	9 18 86	6.7	9 16 87	6.6
2468	146	"	22.5	+ 0 26	4	5.6	5.6	7 20 82	5.8	9 16 87	5.5	10 13 87	5.5
2469	147	"	23.1	− 5 49	4	6.65	6.6	7 20 82	6.5	9 18 86	6.7	9 16 87	6.6
2470	148	"	23.7	4 16	3	6.9	6.9	7 20 82	6.95	9 18 86	6.9	6 29 88	6.9
2471	149	"	23.8	23 52	4	5.15	5.2	7 13 82	5.1	6 30 86	5.2	7 6 88	5.2
2472	150	"	24.0	0 57	4	5.6	5.7	7 20 82	5.5	9 16 87	5.6	6 29 88	5.55
2473	151	"	24.0	26 10	5	6.1	6.2	7 13 82	6.1	6 30 86	6.3	9 16 87	5.9
2474	153	"	26.8	5 39	4	5.85	5.9	7 20 82	5.8	9 18 86	5.8	6 29 88	5.95
2475	154	"	27.8	21 57	3	6.7	6.5	7 13 82	6.7	9 21 86	6.65	7 6 88	6.7
2476	6	*Serpentis Cau.*	27.8	11 9	4	5.8	5.8	7 20 82	5.8	6 30 86	5.9	9 16 87	5.8
2477	7	" "	28.1	13 33	4	6.9	6.9	7 20 82	6.9	6 30 86	6.75	9 16 87	7.0
2478	156	*Ophiuchi*	29.0	6 2	3	6.7	6.9	7 20 82	6.75	9 18 86	6.7	6 29 88	6.7
2479	8	*Serpentis Cau.*	30.4	15 19	4	3.85	3.7	6 30 86	3.7	9 30 86	3.9	9 16 87	3.9
2480	9	" "	30.4	15 30	7	6.7	6.8	7 20 82	6.9	6 30 86	6.5	9 30 86	6.8
2481	157	*Ophiuchi*	17 31.1	8 2	4	4.7	4.7	7 19 82	4.7	6 30 86	4.7	9 30 86	4.8

No	U. A No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U.A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
2482	10	*Serpentis Cau.*	17 31.2	−10 51	4	6.15	6.1	7 20 82	6.1	6 30 86	6.2	9 16 87	6.1
2483	158	*Ophiuchi*	31.2	21 50	4	6.65	6.8	7 13 82	6.5	9 21 86	6.65	9 16 87	6.7
2484	161	"	33.5	0 34	3	6.65	6.4	9 5 82	6.6	9 16 87	6.7	7 6 88	6.7
2485	162	"	33.7	2 5	5	6.55	6.5	9 5 82	6.6	9 16 87	6.4	10 13 87	6.45
2486	11	*Serpentis Cau.*	34.4	12 48	4	4.5	4.7	7 19 82	4.5	6 30 86	4.55	9 30 86	4.6
2487	163	*Ophiuchi*	35.4	27 49	5	6.6	6.8	8 13 82	6.45	7 16 84	6.6	9 21 86	6.6
2488	165	"	36.0	21 37	4	5.5	5.4	7 13 82	5.6	9 22 86	5.6	9 24 88	5.4
2489	166	"	36.0	4 47	5	7.05	6.7	9 15 82	7.0	9 16 87	7.0	7 6 88	7.2
2490	1	*Sagittarii*	36.9	22 8	4	6.85	6.8	7 13 82	6.9	9 21 86	6.85	7 3 88	6.7
2491	12	*Serpentis Cau.*	36.8	13 27	7	6.65	6.6	7 20 82	6.4	6 30 86	6.7	9 16 87	6.55
2492	167	*Ophiuchi*	37.0	7 1	3	6.5	6.6	7 20 82	6.5	9 18 86	6.5	9 16 87	6.5
2493	3	*Sagittarii*	40.2	22 26	4	6.75	6.7	7 13 82	6.7	9 21 86	6.85	9 16 87	6.75
2494	13	*Serpentis Cau.*	40.5	14 41	4	6.1	6.1	7 20 82	6.1	6 30 86	6.1	9 30 86	6.05
2495	4	*Sagittarii*	40.7	26 56	5	6.7	6.7	8 13 82	6.9	7 16 84	6.6	9 21 86	6.6
2496	5	"	42.5	27 1	7	7.1	7.0	8 13 82	7.25	7 16 84	7.1	9 21 86	7.2
2497	6	"	44.4	19 29	3	6.95	6.9	9 13 82	7.0	9 22 86	6.9	7 3 88	6.95
2498	176	*Ophiuchi*	45.5	1 12	3	6.7	6.6	7 15 84	6.75	9 20 86	6.8	7 6 88	6.65
2499	7	*Sagittarii*	45.7	27 15	8	6.9	6.8	8 13 82	6.45	7 16 84	6.7	9 21 86	7.1
2500	175	*Ophiuchi*	46.0	6 7	..	var.	6.7	9 5 82	6.4	9 18 86	6.5	10 19 86	6.5
2501	178	"	46.0	5 14	5	6.95	7.0	9 5 82	6.8	9 18 86	7.1	10 19 86	7.0
2502	14	*Serpentis Cau.*	46.1	10 52	3	6.6	6.4	9 5 82	6.6	6 30 86	6.7	6 29 88	6.5
2503	15	" "	47.2	11 19	4	6.85	6.7	9 5 82	7.0	6 30 86	6.75	9 16 87	6.8
2504	8	*Sagittarii*	47.2	24 52	5	6.5	6.6	9 3 82	6.6	9 22 86	6.3	9 17 87	6.6
2505	181	*Ophiuchi*	47.6	1 35	3	6.85	6.9	7 15 84	6.85	9 20 86	6.85	10 8 88	6.8
2506	9	*Sagittarii*	48.6	18 47	9	6.7	6.7	9 13 82	6.95	9 22 86	6.6	10 19 86	6.8
2507	10	"	48.8	28 3	5	6.0	6.0	8 13 82	6.1	9 12 86	5.95	9 16 87	6.0
2508	11	"	48.8	21 56	5	7.0	7.0	9 3 82	7.0	9 22 86	7.1	9 16 87	7.0
2509	16	*Serpentis Cau.*	49.1	15 47	4	5.95	5.9	9 5 82	5.85	9 30 86	5.9	6 29 88	6.05
2510	183	*Ophiuchi*	50.2	4 4	4	5.7	5.8	9 5 82	5.8	9 18 86	5.6	10 19 86	5.7
2511	184	"	50.7	+ 0 5	2	6.4	6.4	7 15 84	6.4	9 20 86	6.4	.. .. ..	...
2512	13	*Sagittarii*	50.7	−28 45	7	6.2	6.2	8 13 82	6.3	7 16 84	6.3	9 21 86	5.95
2513	14	"	51.1	30 14	4	5.6	5.4	8 13 82	5.5	9 21 86	5.6	7 10 88	5.7
2514	186	*Ophiuchi*	52.2	9 45	4	3.5	3.5	6 30 86	3.5	9 20 86	3.6	9 30 86	3.35
2515	15	*Sagittarii*	52.2	23 18	3	5.35	5.4	9 3 82	5.4	9 22 86	5.3	7 10 88	5.3
2516	16	"	52.6	20 20	5	6.75	6.7	9 13 82	6.6	9 22 86	6.9	10 19 86	6.9
2517	187	*Ophiuchi*	53.0	4 18	5	6.35	6.1	9 5 82	6.4	9 18 86	6.5	10 19 86	6.2
2518	188	"	53.9	+ 0 38	3	6.7	6.8	7 15 84	6.65	9 23 86	6.7	7 6 88	6.7
2519	17	*Serpentis Cau.*	53.9	− 3 41	3	4.95	4.9	9 5 82	5.0	9 20 86	4.9	6 29 88	4.95
2520	18	*Sagittarii*	54.1	17 9	4	7.0	6.9	9 5 82	7.05	9 16 87	7.0	7 10 88	6.9
2521	21	"	54.3	22 47	5	6.3	6.3	9 13 82	6.2	9 22 86	6.2	9 16 87	6.3
2522	...	"	55.0	22 54	4	7.15	7.1	9 3 82	7.0	9 22 86	7.25	9 16 87	7.2
2523	19	"	55.2	20 44	4	6.95	7.0	9 3 82	6.95	9 22 86	6.9	7 3 88	6.95
2524	20	"	55.2	24 17	3	5.95	5.9	9 3 82	5.9	9 22 86	5.9	10 2 86	6.0
2525	22	"	55.5	22 43	3	6.95	7.0	9 3 82	7.0	9 22 86	6.9	7 10 88	6.95
2526	18	*Serpentis Cau.*	55.9	3 9	3	6.85	6.9	9 5 82	6.8	7 15 84	6.85	9 20 86	6.9
2527	194	*Ophiuchi*	56.1	5 21	6	6.9	6.9	9 5 82	6.6	9 18 86	7.1	10 19 86	7.1
2528	24	*Sagittarii*	56.2	24 22	6	6.3	6.0	9 3 82	6.1	9 22 86	6.5	9 16 87	6.2
2529	195	*Ophiuchi*	56.3	8 11	3	5.25	5.3	9 5 82	5.3	9 16 87	5.2	7 6 88	5.2
2530	23	*Sagittarii*	56.7	22 30	7	6.95	6.8	9 3 82	7.0	9 22 86	6.8	10 13 87	7.0
2531	26	"	57.0	29 35	3	var.	var.	8 13 82	5.6	9 21 86	5.0	7 10 88	5.25
2532	27	"	57.5	24 24	3	6.6	6.5	9 3 82	6.4	10 13 87	6.7	9 24 88	6.8
2533	28	"	57.8	30 25	5	3.2	2.8	7 6 82	3.2	7 7 82	3.0	7 16 82	3.4
2534	19	*Serpentis Cau.*	17 59.3	8 20	6	6.0	6.2	9 5 82	5.8	9 20 86	6.0	9 15 87	6.2

No.	U. A. No.	Name.	1875.		No. Obs.	Mag.		Separate Observations.					
			R. A.	Decl.		Mean Obs'd.	U.A.	Date.	Mag.	Date.	Mag	Date.	Mag
			h. m.	° ′									
2535	20	*Serpentis Cau.*	17 59.6	− 4 46	5	5.95	6.0	9 5 82	6.1	9 18 86	5.9	10 19 86	5.9
2536	21	" "	59.7	0 27	3	6.7	6.7	7 15 84	6.65	9 20 86	6.7	6 29 88	6.7
2537	30	*Sagittarii*	17 59.7	21 27	4	6.55	6.7	9 13 82	6.6	9 22 86	6.6	7 3 88	6.5
2538	31	"	18 0.2	28 28	3	5.1	5.1	8 13 82	5.05	9 21 86	5.0	9 30 88	5.25
2539	32	"	0.6	17 10	4	5.9	5.9	9 5 82	5.85	9 22 86	5.8	10 16 86	5.9
2540	22	*Serpentis Cau.*	0.4	3 15	3	6.95	7.0	9 15 82	7.0	7 15 84	6.95	9 20 86	6.9
2541	34	*Sagittarii*	1.2	21 28	6	6.95	7.0	9 13 82	6.9	9 22 86	6.9	7 3 88	6.95
2542	35	"	1.5	26 7	..	var.?	6.7	9 5 82	6.9	10 2 86	7.1	10 13 87	8.0
2543	37	"	2.0	30 45	5	6.0	5.9	9 5 82	6.05	9 21 86	5.95	7 10 88	6.0
2544	23	*Serpentis Cau.*	2.1	2 56	3	6.95	6.8	9 15 82	7.0	7 15 84	6.95	9 20 86	6.9
2545	24	" "	2.7	13 57	3	6.8	6.7	9 17 82	6.8	9 30 86	6.7	8 29 88	6.85
2546	39	*Sagittarii*	3.8	19 52	2	6.6	6.6	9 13 82	6.6	9 22 86	6.6	.. .. ..	...
2547	40	"	4.1	23 43	4	5.65	5.7	9 3 82	5.75	10 2 86	5.55	9 16 87	5.55
2548	25	*Serpentis Cau.*	4.8	5 14	7	6.9	7.0	9 5 82	6.6	9 20 86	6.75	9 10 87	6.95
2549	41	*Sagittarii*	6.3	21 5	2	4.2	4.3	9 5 82	4.2	9 22 86	4.2	.. .. ..	...
2550	26	*Serpentis Cau.*	6.6	4 3	5	6.7	6.8	9 5 82	6.6	9 20 86	6.75	9 10 87	6.75
2551	42	*Sagittarii*	6.8	21 45	4	6.15	6.0	9 3 82	6.1	9 22 86	6.2	9 16 87	6.2
2552	43	"	7.8	20 46	4	5.7	5.8	9 3 82	5.8	9 22 86	5.7	10 16 86	5.6
2553	44	"	7.8	20 25	5	6.25	6.6	9 3 82	6.3	9 22 86	6.3	9 16 87	6.3
2554	45	"	8.2	18 42	4	6.3	6.5	9 5 82	6.3	9 22 86	6.25	10 16 86	6.4
2555	27	*Serpentis Cau.*	9.4	3 39	6	6.6	6.6	9 5 82	6.4	9 20 86	6.6	9 10 87	6.55
2556	48	*Sagittarii*	9.5	28 19	3	6.7	6.7	9 5 82	6.7	10 2 86	6.65	7 10 88	6.75
2557	49	"	9.5	28 42	4	6.55	6.6	9 5 82	6.5	10 2 86	6.4	7 10 88	6.65
2558	50	"	9.9	17 25	6	6.55	6.4	.9 5 82	6.3	9 22 86	6.6	10 16 86	6.6
2559	51	"	10.2	27 5	5	5.1	5.1	8 13 82	4.9	10 2 86	5.2	10 19 86	5.1
2560	52	"	10.2	18 30	5	6.95	6.9	9 5 82	7.05	9 16 87	6.9	11 2 87	6.95
2561	28	*Serpentis Cau.*	10.3	3 2	5	6.45	6.3	9 5 82	6.4	9 20 86	6.5	9 10 87	6.35
2562	29	" "	10.5	9 48	4	6.5	6.5	9 4 82	6.45	9 20 86	6.4	8 29 88	6.6
2563	...	*Sagittarii*	10.5	18 51	4	7.0	7.1	9 5 82	7.05	9 16 87	7.0	7 10 88	6.9
2564	53	"	11.0	25 39	3	7.0	6.9	8 13 82	7.0	9 21 86	6.9	7 10 88	7.05
2565	30	*Serpentis Cau.*	11.1	12 17	4	6.9	6½	9 17 82	6.9	9 30 86	7.0	8 29 88	6.8
2566	...	*Sagittarii*	11.4	18 40	4	6.95	7.0	9 5 82	7.05	9 16 87	7.0	7 10 88	6.9
2567	31	*Serpentis Cau.*	12	13 50	4	6.75	6¾	9 17 82	6.9	9 30 86	6.55	9 15 87	6.75
2568	32	" "	13.0	15 53	3	5.9	5.8	9 5 82	5.85	9 15 87	5.9	9 24 88	6.0
2569	54	*Sagittarii*	13.0	29 53	4	3.05	2.8	7 6 82	3.1	7 7 82	3.0	7 16 84	3.1
2570	33	*Serpentis Cau.*	13.3	8 2	3	6.75	6.6	9 4 82	6.8	9 20 86	6.75	8 29 88	6.75
2571	55	*Sagittarii*	13.4	26 8	2	7.0	7.0	8 13 82	7.0	9 21 86	7.0	.. .. ..	...
2572	56	"	13.8	24 58	6	6.9	var.	8 13 82	7.0	9 21 86	7.0	9 16 87	6.9
2573	57	"	14.0	18 55	2	var.	6.0	9 5 82	6.15	9 22 86	6.6	.. .. ..	...
2574	58	"	14.1	28 29	3	6.45	6.5	9 5 82	6.5	10 2 86	6.4	7 10 88	6.4
2575	34	*Serpentis Cau.*	14.8	2 56	4	3.4	3.5	9 20 86	3.3	9 15 87	3.4	8 29 88	3.4
2576	1	*Scuti*	16.1	10 17	3	6.6	6.8	9 14 82	6.6	9 20 86	6.5	8 29 88	6.65
2577	2	"	16.2	12 4	3	6.1	6.0	9 4 82	6.2	9 20 86	6.0	9 14 87	6.1
2578	3	"	16.8	9 0	6	5.15	5.3	9 4 82	5.0	9 20 86	5.2	9 14 87	5.1
2579	63	*Sagittarii*	17.0	30 49	3	5.95	6.0	9 5 82	5.85	10 1 86	5.9	7 10 88	6.05
2580	36	*Serpentis Cau.*	17.5	3 39	11	6.6	6.7	9 5 82	6.4	9 20 86	6.6	9 15 87	6.8
2581	4	*Scuti*	17.9	7 8	3	6.8	6.7	9 4 82	6.8	9 20 86	6.75	8 29 88	6.8
2582	65	*Sagittarii*	17.9	20 36	7	5.3	5.1	9 5 82	4.95	9 22 86	5.3	10 16 86	5.2
2583	37	*Serpentis Cau.*	18.5	1 39	3	6.5	6.4	9 4 82	6.5	9 20 86	6.5	8 30 88	6.45
2584	66	*Sagittarii*	19.8	29 53	3	6.25	6.2	9 5 82	6.25	10 1 86	6.3	7 10 88	6.15
2585	68	"	19.9	26 42	2	6.8	6.8	8 13 82	6.8	9 21 86	6.8	.. .. ..	...
2586	67	"	20.3	25 29	4	3.0	2.7	7 6 82	3.0	7 7 82	3.0	7 16 84	2.9
2587	69	"	18 20.3	26 50	3	6.7	6.6	8 13 82	6.7	9 21 86	6.75	7 10 88	6.7

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
2588	5	*Scuti*	18 20.4	− 8 7	4	6.85	7.0	9 4 82	6.9	9 20 86	6.75	9 14 87	6.9
2589	71	*Sagittarii*	20.7	17 53	3	6.55	6.6	9 5 82	6.6	9 22 86	6.5	10 16 86	6.5
2590	41	*Serpentis Cau.*	20.8	+ 0 7	3	5.65	5.5	9 4 82	5.6	9 20 86	5.7	8 30 88	5.6
2591	70	*Sagittarii*	21.2	−26 40	2	6.8	6.9	8 13 82	6.8	9 21 86	6.8	.. .. ..	...
2592	72	"	21.3	29 20	3	6.95	7.0	9 5 82	6.9	10 1 86	7.0	7 10 88	7.0
2593	73	"	21.7	25 20	4	6.8	7.0	8 13 82	6.9	9 21 86	6.8	7 10 88	6.8
2594	6	*Scuti*	22.1	14 39	3	4.75	4.8	9 17 82	4.8	9 14 87	4.7	8 29 88	4.8
2595	7	"	22.7	14 40	4	6.65	6.5	9 17 82	6.8	9 29 86	6.6	9 14 87	6.7
2596	74	*Sagittarii*	22.9	18 48	5	6.2	6.0	9 5 82	6.3	9 22 86	6.15	10 16 86	6.15
2597	45	*Serpentis Cau.*	23.2	2 4	3	5.85	5.8	9 4 82	5.8	9 20 86	5.9	8 30 88	5.8
2598	8	*Scuti*	23.6	5 48	4	6.6	6.5	9 4 82	6.45	9 20 86	6.7	9 14 87	6.6
2599	76	*Sagittarii*	24.1	18 29	5	5.2	5.5	9 5 82	5.4	9 22 86	5.1	9 16 87	5.0
2600	9	*Scuti*	24.5	10 53	4	6.0	6.1	9 4 82	6.0	9 20 86	5.95	9 14 87	6.05
2601	...	"	25.2	14 44	5	6.8	...	9 17 82	6.8	9 29 86	6.6	9 14 87	6.7
2602	48	*Serpentis Cau.*	25.5	1 5	4	6.2	6.3	9 4 82	6.25	9 20 86	6.2	9 15 87	6.15
2603	10	*Scuti*	25.6	14 57	9	6.3	5.9	9 17 82	6.0	9 29 86	6.4	10 23 86	6.45
2604	78	*Sagittarii*	26.3	24 7	4	6.05	5.9	9 5 82	5.9	9 21 86	6.1	9 16 87	6.1
2605	11	*Scuti*	26.5	14 57	7	6.1	6.4	9 17 82	6.3	9 29 86	6.0	9 14 87	6.0
2606	12	"	26.7	6 0	3	6.45	6.5	9 14 82	6.45	9 20 86	6.5	9 14 87	6.45
2607	...	*Sagittarii*	26.9	24 19	3	6.85	...	9 5 82	7.0	9 21 86	6.7	9 16 87	6.8
2608	79	"	27.9	20 56	3	6.8	6.8	8 13 82	6.8	9 15 87	6.8	7 10 88	6.75
2609	80	"	28.0	29 48	4	6.85	6.9	9 5 82	6.7	10 1 86	6.9	9 16 87	7.05
2610	13	*Scuti*	28.1	11 4	5	5.65	5.7	9 4 82	5.8	9 17 82	5.35	9 20 86	5.7
2611	14	"	28.4	8 20	6	3.75	3.6	8 12 82	3.55	9 20 86	3.85	9 24 86	4.0
2612	81	*Sagittarii*	28.8	24 1	4	6.4	6.1	9 5 82	6.5	9 21 86	6.3	10 13 87	6.45
2613	82	"	29.2	28 37	2	7.0	7.0	9 5 82	7.0	10 1 86	7.0	.. .. ..	...
2614	83	"	30.4	21 30	3	6.05	6.2	8 13 82	6.05	9 15 87	6.0	7 10 88	6.1
2615	84	"	30.9	23 37	3	6.05	6.1	9 5 82	6.2	9 21 86	6.1	7 10 88	5.9
2616	56	*Serpentis Cau.*	31.0	3 1	3	6.9	6.8	9 4 82	6.85	9 21 86	6.9	8 30 88	6.9
2617	15	*Scuti*	31.0	14 7	4	6.6	6.6	9 17 82	6.55	9 29 86	6.6	9 14 87	6.5
2618	16	"	31.1	4 55	3	6.95	7.0	9 4 82	6.9	9 20 86	7.0	8 30 88	6.95
2619	57	*Serpentis Cau.*	31.2	0 25	3	6.0	6.1	9 4 82	6.0	9 20 86	5.9	8 30 88	6.05
2620	58	" "	31.4	2 42	3	6.9	6.9	9 4 82	6.9	9 21 86	6.9	8 30 88	6.9
2621	86	*Sagittarii*	31.4	21 9	4	6.15	6.0	8 13 82	6.05	9 15 87	6.25	10 13 87	6.1
2622	60	*Serpentis Cau.*	31.8	3 18	3	6.7	6.7	9 4 82	6.7	9 21 86	6.7	8 30 88	6.7
2623	61	" "	31.9	1 13	3	6.8	6.8	9 4 82	6.7	9 21 86	6.8	8 30 88	6.9
2624	87	*Sagittarii*	32.5	20 11	4	6.95	7.0	8 13 82	6.8	9 15 87	7.0	9 16 87	7.0
2625	17	*Scuti*	33.2	7 54	10	6.6	6.4	9 14 82	6.25	9 20 86	6.7	10 23 86	6.9
2626	88	*Sagittarii*	34.2	23 57	4	6.4	6.6	9 5 82	6.5	9 21 86	6.4	7 10 88	6.35
2627	18	*Scuti*	34.6	14 41	7	6.7	6.7	9 17 82	6.55	9 29 86	6.6	10 23 86	6.8
2628	65	*Serpentis Cau.*	35.0	3 14	3	6.9	6.9	9 4 82	6.85	9 21 86	6.9	8 30 88	6.9
2629	19	*Scuti*	35.4	9 10	6	5.1	5.1	8 12 82	5.1	9 4 82	5.2	9 20 86	5.2
2630	89	*Sagittarii*	35.6	19 24	4	7.0	6.9	8 13 82	7.1	9 15 87	6.95	10 13 87	7.0
2631	20	*Scuti*	35.9	7 12	4	6.65	6.7	9 4 82	6.6	9 20 86	6.8	9 14 87	6.65
2632	21	"	36.7	8 24	9	5.3	5.2	8 12 82	5.55	9 4 82	5.4	9 20 86	5.4
2633	92	*Sagittarii*	36.8	19 27	4	7.0	7.0	8 13 82	7.1	9 15 87	6.95	10 13 87	7.0
2634	22	*Scuti*	37.1	6 56	4	6.7	6.7	9 4 82	6.6	9 20 86	6.8	9 14 87	6.75
2635	94	*Sagittarii*	37.1	25 8	6	6.0	6.2	9 5 82	5.85	9 21 86	5.95	9 16 87	6.1
2636	95	"	37.9	27 7	7	3.3	3.7	7 6 82	3.1	7 7 82	3.4	9 5 82	3.5
2637	96	"	37.9	21 8	4	6.6	6.7	8 13 82	6.45	9 20 86	6.65	9 15 87	6.6
2638	97	"	38.2	27 38	5	7.0	7.0	9 5 82	7.1	9 29 86	6.9	9 16 87	7.1
2639	1	*Aquilæ*	38.5	0 30	4	7.0	7.0	10 2 82	7.1	9 21 86	6.9	9 14 87	7.0
2640	98	*Sagittarii*	18 38.6	19 44	4	6.9	6.9	8 13 82	6.8	9 15 87	7.0	10 13 87	6.85

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			h. m	° ′									
2641	99	*Sagittarii*	18 38.8	−22 31	8	5.9	5.6	8 12 82	5.9	7 16 84	5.9	9 20 86	6.25
2642	23	*Scuti*	39.8	10 15	3	6.25	6.2	9 4 82	6.25	9 14 87	6.25	8 30 88	6.25
2643	3	*Aquilæ*	40.0	1 6	2	6.3	6.2	10 2 82	6.3	9 21 86	6.3	.. .. ..	....
2644	24	*Scuti*	40.5	4 53	5	4.5	4.5	8 12 82	4.6	9 20 86	4.15	9 14 87	4.7
2645	103	*Sagittarii*	41.4	18 44	6	6.55	6.8	8 13 82	6.8	9 15 87	6.5	10 13 87	6.45
2646	26	*Scuti*	42.0	6 9	3	6.85	7.0	9 21 86	6.9	9 14 87	6.85	10 30 88	6.8
2647	104	*Sagittarii*	42.3	20 28	5	5.7	5.5	8 13 82	5.7	9 22 86	5.7	7 10 88	5.5
2648	27	*Scuti*	43.0	6 3	5	6.6	6.5	9 21 86	6.7	9 14 87	6.6	10 8 88	6.55
2649	4	*Aquilæ*	43.3	+ 0 42	4	6.5	6.6	9 21 86	6.5	9 14 87	6.55	10 12 87	6.5
2650	105	*Sagittarii*	43.3	−22 18	5	6.65	6.6	8 12 82	6.6	7 16 84	6.7	9 20 86	6.65
2651	28	*Scuti*	43.5	13 43	4	6.8	7.0	9 17 82	6.8	9 29 86	7.0	9 14 87	6.7
2652	29	"	44.1	9 55	4	6.45	6.4	9 4 82	6.6	9 14 87	6.45	10 12 87	6.4
2653	...	*Aquilæ*	44.5	3 24	8	7.35	7.5	10 2 82	7.1	9 21 86	7.4	10 19 86	7.5
2654	106	*Sagittarii*	44.6	22 4	5	6.9	7.0	8 12 82	6.9	7 16 84	6.9	9 20 86	6.8
2655	108	"	44.7	29 32	4	6.6	6.5	9 5 82	6.7	9 29 86	6.75	9 6 87	6.5
2656	109	"	44.7	26 48	3	6.8	6.8	9 5 82	6.8	9 29 86	6.8	10 30 88	6.8
2657	5	*Aquilæ*	44.8	3 28	3	6.5	6.5	10 2 82	6.5	9 21 86	6.45	8 30 88	6.6
2658	31	*Scuti*	46.2	9 44	4	6.75	6.7	9 4 82	6.85	9 14 87	6.65	10 12 87	6.8
2659	110	*Sagittarii*	46.5	21 31	6	6.4	6.0	8 12 82	6.35	7 16 84	6.2	9 20 86	6.45
2660	111	"	46.6	22 54	4	4.9	5.0	8 12 82	4.9	7 16 84	5.0	9 20 86	4.8
2661	112	"	47.5	26 27	5	2.4	2.4	7 6 82	2.5	7 7 82	2.2	9 5 82	2.5
2662	113	"	47.6	22 50	4	5.1	5.1	8 12 82	5.05	7 16 84	5.1	9 20 86	5.0
2663	32	*Scuti*	47.6	15 45	3	5.4	5.5	9 15 82	5.3	9 24 86	5.35	8 29 88	5.5
2664	114	*Sagittarii*	48.3	16 32	6	5.7	5.8	9 15 82	5.65	9 24 86	5.55	9 16 87	5.5
2665	116	"	48.4	23 20	6	6.2	6.4	8 12 82	6.35	7 16 84	6.4	9 20 86	6.25
2666	117	"	48.5	18 41	4	6.95	6.9	8 12 82	6.95	9 24 86	6.9	10 13 87	7.0
2667	6	*Aquilæ*	49.9	1 58	3	6.5	6.6	10 2 82	6.5	9 21 86	6.5	10 30 88	6.5
2668	119	*Sagittarii*	49.9	20 49	9	5.15	5.7	8 12 82	5.5	7 16 84	5.3	9 20 86	5.0
2669	120	"	50.3	21 16	6	3.65	3.5	8 12 82	3.5	9 5 82	3.6	7 10 88	3.65
2670	33	*Scuti*	50.4	6 0	7	5.25	5.4	8 12 82	5.1	9 30 86	5.5	9 14 87	5.15
2671	122	*Sagittarii*	50.7	25 2	3	6.8	6.7	8 12 82	6.8	9 29 86	6.8	9 6 88	6.8
2672	123	"	50.9	22 42	5	6.35	6.6	8 12 82	6.35	7 16 84	6.4	9 20 86	6.25
2673	124	"	52.0	12 45	4	7.0	7.0	9 17 82	7.0	9 24 86	6.8	9 16 87	7.0
2674	125	"	52.1	18 44	3	6.9	6.9	8 12 82	6.95	9 24 86	6.9	8 29 88	6.9
2675	126	"	52.4	13 1	3	5.75	5.6	9 17 82	5.75	9 24 86	5.75	10 30 88	5.8
2676	127	"	52.8	25 7	3	6.8	6.6	8 12 82	6.8	9 29 86	6.8	9 6 88	6.8
2677	128	"	54.1	22 52	6	6.8	6.8	8 12 82	6.6	7 16 84	6.7	9 20 86	7.0
2678	129	"	54.4	15 27	3	6.6	6.6	9 15 82	6.65	9 24 86	6.6	8 29 88	6.6
2679	130	"	54.7	30 3	6	2.75	3.1	7 6 82	2.7	7 7 82	2.7	9 5 82	3.0
2680	131	"	54.8	25 1	3	6.1	6.1	8 12 82	6.15	9 29 86	6.1	9 6 88	6.1
2681	9	*Aquilæ*	55.0	5 55	5	4.05	3.8	8 12 82	4.0	9 20 86	4.0	9 24 86	4.2
2682	10	"	55.7	10 54	5	6.9	6.8	9 15 82	7.1	9 14 87	6.8	10 12 87	6.8
2683	132	*Sagittarii*	55.7	19 25	2	6.4	6.4	8 12 82	6.4	9 24 86	6.4	.. .. ..	...
2684	133	"	55.8	19 17	3	6.7	6.8	8 12 82	6.6	9 24 86	6.8	9 15 87	6.7
2685	11	*Aquilæ*	56.3	3 53	5	5.7	5.7	8 12 82	5.85	9 21 86	5.7	9 30 86	5.7
2686	135	*Sagittarii*	56.7	23 5	5	7.05	6.9	8 12 82	7.1	7 16 84	6.9	9 20 86	7.2
2687	136	"	57.2	21 55	4	4.0	3.8	8 12 82	4.0	9 5 82	3.9	7 10 88	4.1
2688	137	"	57.9	29 16	4	7.0	7.0	9 5 82	7.0	9 16 87	7.1	9 17 87	7.0
2689	15	*Aquilæ*	58.4	4 13	8	5.85	5.6	8 12 82	5.55	9 21 86	6.0	9 30 86	5.85
2690	138	*Sagittarii*	58.5	15 51	4	6.1	5.9	9 15 82	6.0	9 24 86	6.1	8 29 88	6.2
2691	16	*Aquilæ*	58.8	1 42	3	6.95	6.8	10 2 82	7.0	9 21 86	6.85	9 14 87	6.95
2692	139	*Sagittarii*	59.1	27 51	5	3.6	3.6	7 6 82	3.5	7 7 82	3.7	9 5 82	3.8
2693	17	*Aquilæ*	18 59.2	9 27	4	7.25	6.9	9 15 82	7.4	9 14 87	7.2	10 22 87	7.1

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			h. m.	° ′									
2694	18	*Aquilæ*	18 59.3	− 9 49	4	7.1	6.8	9 15 82	7.1	9 14 87	7.1	9 26 88	7.1
2695	19	"	59.6	5 4	8	3.3	3.3	8 12 82	3.0	9 20 86	3.4	9 24 86	3.6
2696	140	*Sagittarii*	59.6	28 50	4	6.65	6.5	9 5 82	6.5	9 29 86	6.65	9 17 87	6.75
2697	141	"	59.7	16 25	4	6.25	6.0	9 15 82	6.25	9 24 86	6.3	9 15 87	6.15
2698	142	"	18 59.8	18 56	4	6.7	6.7	8 12 82	6.8	9 24 86	6.7	8 29 88	6.5
2699	21	*Aquilæ*	19 0.1	1 32	4	7.05	7.0	10 2 82	7.1	9 21 86	6.9	9 17 87	7.1
2700	143	*Sagittarii*	0.6	24 51	4	6.6	6.7	8 12 82	6.7	9 29 86	6.5	9 15 87	6.5
2701	23	*Aquilæ*	0.8	+ 0 27	2	6.8	6.7	10 2 82	6.8	9 21 86	6.8	.. .. ..	...
2702	144	*Sagittarii*	0.9	− 19 29	3	5.85	5.8	8 12 82	5.8	9 24 86	5.8	8 29 88	6.0
2703	145	"	1.1	25 16	3	6.85	7.0	8 12 82	6.9	9 29 86	6.8	9 6 88	6.8
2704	147	"	2.3	21 13	4	3.0	3.1	8 12 82	2.9	9 5 82	3.0	9 6 88	2.9
2705	148	"	2.4	20 0	3	6.75	6.8	8 12 82	6.8	9 24 86	6.8	8 29 88	6.6
2706	149	"	2.5	30 12	5	6.7	6.7	9 5 82	6.7	9 29 86	6.7	9 17 87	6.7
2707	150	"	3.4	29 42	4	6.35	6.5	9 5 82	6.3	9 29 86	6.3	9 17 87	6.3
2708	25	*Aquilæ*	3.4	0 38	2	6.7	6.6	10 2 82	6.7	9 21 86	6.7	.. .. ..	...
2709	26	"	4.3	6 50	5	7.0	7.0	9 15 82	7.1	9 21 86	7.0	9 17 87	7.0
2710	151	*Sagittarii*	5.0	21 52	5	7.0	6.9	9 15 82	6.8	9 29 86	7.0	9 15 87	7.2
2711	152	"	5.5	26 7	3	6.2	6.3	8 12 82	6.15	9 29 86	6.1	9 6 88	6.3
2712	28	*Aquilæ*	5.9	8 9	4	5.8	5.9	9 15 82	5.9	9 21 86	5.7	9 30 86	5.7
2713	153	*Sagittarii*	6.3	12 29	3	5.95	5.8	9 17 82	6.0	9 29 86	5.9	9 26 88	5.9
2714	154	"	6.7	30 3	5	7.0	7.0	9 5 82	6.9	9 17 87	7.0	9 26 88	7.05
2715	29	*Aquilæ*	7.4	+ 2 5	3	5.55	5.7	10 19 86	5.55	10 22 86	5.55	9 26 88	5.5
2716	...	"	7.4	− 8 56	5	6.9	...	9 15 82	6.6	9 21 86	7.0	9 17 87	7.0
2717	155	*Sagittarii*	7.9	25 28	4	5.45	5.4	8 12 82	5.5	9 29 86	5.45	9 26 88	5.35
2718	157	"	7.9	24 23	3	6.6	6.7	8 12 82	6.55	9 29 86	6.7	9 15 87	6.6
2719	158	"	8.3	30 41	6	6.95	7.0	9 5 82	7.0	9 17 87	6.75	11 9 87	7.05
2720	31	*Aquilæ*	8.7	6 16	5	6.9	6.8	9 15 82	6.7	9 21 86	7.0	9 17 87	6.95
2721	160	*Sagittarii*	10.3	19 10	8	5.3	5.6	8 12 82	5.4	9 29 86	5.1	10 19 86	5.2
2722	...	"	10.5	16 11	4	6.8	6.9	9 15 82	6.9	9 17 87	6.8	9 30 88	6.75
2723	161	"	10.9	19 5	3	7.25	7.0	10 1 82	7.3	9 17 87	7.3	10 19 87	7.2
2724	...	"	11.2	18 55	3	7.45	7.2	9 17 87	7.5	10 12 87	7.5	10 17 89	7.4
2725	163	"	11.9	15 45	3	6.65	6.7	9 15 82	6.65	9 17 87	6.7	9 30 88	6.6
2726	...	*Aquilæ*	12.1	+ 0 12	3	7.1	7.1	10 2 82	7.2	10 1 86	7.0	9 26 88	7.05
2727	35	"	12.2	0 52	4	5.9	5.7	10 2 82	5.9	10 1 86	5.9	10 19 86	5.85
2728	36	"	12.5	0 7	4	6.95	6.8	10 2 82	6.85	10 1 86	7.0	9 17 87	7.0
2729	165	*Sagittarii*	13.2	− 22 38	4	5.8	5.9	9 15 82	5.9	9 29 86	5.7	9 17 87	5.8
2730	170	"	13.7	29 50	4	6.95	7.0	9 15 82	6.8	9 29 86	7.0	9 17 87	7.0
2731	38	*Aquilæ*	13.9	5 39	4	5.55	5.6	9 15 82	5.6	9 21 86	5.5	9 30 86	5.5
2732	39	"	14.0	1 33	4	6.75	6.8	10 2 82	6.85	10 1 86	6.75	9 26 88	6.6
2733	40	"	14.2	1 7	3	5.8	5.9	10 2 82	5.8	10 1 86	5.8	9 26 88	5.8
2734	171	*Sagittarii*	14.2	29 45	4	6.95	7.0	9 15 82	6.8	9 29 86	7.0	9 17 87	7.1
2735	173	"	14.3	·19 28	3	6.45	6.6	10 1 82	6.4	9 17 87	6.4	9 6 88	6.55
2736	174	"	14.4	18 5	5	4.25	4.2	8 12 82	4.4	9 29 86	4.45	9 26 88	4.2
2737	175	"	14.6	18 32	4	6.5	6.5	10 1 82	6.4	9 17 87	6.55	10 12 87	6.55
2738	176	"	14.6	16 11	4	4.8	4.9	8 12 82	4.9	9 29 86	4.8	9 26 88	4.65
2739	41	*Aquilæ*	15.6	8 26	4	6.75	6.9	9 15 82	6.6	9 21 86	6.8	9 17 87	6.75
2740	42	"	15.9	0 29	3	6.35	6.3	10 2 82	6.3	10 1 86	6.35	9 26 88	6.35
2741	43	"	16.3	7 38	4	6.7	6.7	9 15 82	6.6	9 21 86	6.8	9 17 87	6.75
2742	179	*Sagittarii*	16.7	28 6	3	6.0	5.9	9 15 82	6.0	9 29 86	6.05	9 6 88	6.0
2743	180	"	17.2	29 33	3	6.2	6.1	9 15 82	6.2	9 29 86	6.3	9 6 88	6.1
2744	181	"	17.7	24 45	5	5.25	5.4	9 15 82	5.2	9 29 86	5.2	10 19 86	5.25
2745	182	"	17.9	24 12	8	5.95	5.6	9 15 82	5.6	9 29 86	5.9	10 19 86	6.0
2746	183	"	19 18.2	22 42	3	6.95	7.0	9 15 82	6.9	9 29 86	7.0	9 6 88	7.0

No.	U. A. No	Name.	1875. R. A.	1875. Decl.	No Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
2747	184	*Sagittarii*	19 18.3	−14 9	7	6.25	5.9	10 1 82	6.3	9 29 86	6.25	10 19 86	6.25
2748	45	*Aquilæ*	18.4	5 8	4	6.75	6.8	9 15 82	6.6	9 21 86	6.9	9 17 87	6.75
2749	185	*Sagittarii*	18.9	22 1	3	6.05	5.9	9 15 82	6.1	9 29 86	6.0	9 6 88	6.05
2750	186	"	19.0	29 59	3	5.6	5.8	9 15 82	5.6	9 29 86	5.5	9 6 88	5.75
2751	187	"	19.1	15 18	4	5.85	5.9	10 1 82	5.9	9 29 86	5.8	9 30 88	5.7
2752	46	*Aquilæ*	19.2	+ 2 52	3	3.35	3.4	9 24 86	3.25	9 17 87	3.3	10 25 88	3.45
2753	188	*Sagittarii*	19.3	−14 48	4	6.8	6.8	10 1 82	6.7	9 29 86	6.8	9 30 88	6.9
2754	47	*Aquilæ*	20.1	+ 0 6	6	5.2	5.4	10 2 82	5.2	9 24 86	5.0	10 19 86	5.2
2755	...	*Sagittarii*	20.4	−18 36	2	7.3	7.3	10 1 82	7.3	9 17 87	7.3	.. .. ..	...
2756	190	"	20.8	18 37	4	7.0	7.0	10 1 82	6.9	9 17 87	7.0	9 26 88	7.05
2757	191	"	21.5	15 21	4	6.85	6.9	10 1 82	6.7	9 29 86	6.8	9 30 88	7.0
2758	193	"	22.1	27 14	3	5.8	5.8	9 15 82	5.8	9 29 86	5.7	9 6 88	5.85
2759	195	"	22.6	12 54	3	6.95	6.9	10 1 82	6.9	9 29 86	7.0	9 26 88	7.0
2760	50	*Aquilæ*	22.6	19 23	..	var.	7.0	9 15 82	6.7	9 21 86	6.8	.. .. ..	...
2761	52	"	22.9	0 1	4	6.75	6.8	10 2 82	6.65	10 1 86	6.8	9 17 87	6.8
2762	197	*Sagittarii*	23.5	21 34	3	6.35	6.2	9 15 82	6.35	9 29 86	6.4	9 6 88	6.3
2763	54	*Aquilæ*	24.1	3 3	4	5.65	5.6	10 2 82	5.5	10 1 86	5.7	9 17 87	5.8
2764	56	"	24.8	2 22	3	7.0	7.0	10 2 82	7.0	10 1 86	6.95	9 26 88	7.05
2765	202	*Sagittarii*	27.0	24 8	4	6.8	6.9	9 15 82	6.7	9 29 86	6.9	9 15 87	6.7
2766	203	"	28.2	21 3	4	6.9	7.0	9 15 82	6.8	9 29 86	7.0	9 15 87	6.8
2767	59	*Aquilæ*	28.2	10 50	4	5.75	5.8	10 1 82	5.65	9 21 86	5.9	9 17 87	5.8
2768	204	*Sagittarii*	28.4	24 59	4	6.0	var.	9 15 82	5.9	9 29 86	6.0	9 15 87	6.0
2769	206	"	28.6	12 32	3	6.65	6.7	10 1 82	6.7	9 29 86	6.6	9 26 88	6.6
2770	60	*Aquilæ*	28.8	7 44	3	6.65	6.7	10 1 82	6.65	9 21 86	6.65	9 26 88	6.6
2771	207	*Sagittarii*	29.1	25 9	7	4.65	4.7	9 15 82	4.95	9 29 86	4.65	10 3 86	4.6
2772	208	"	29.2	19 8	4	6.25	6.3	10 1 82	6.4	9 29 86	6.2	9 15 87	6.35
2773	209	"	29.8	18 30	8	6.05	5.8	10 1 82	6.2	9 29 86	6.1	10 19 86	6.0
2774	211	"	30.0	13 27	3	6.95	7.0	10 1 82	7.0	9 29 86	7.0	9 26 88	6.9
2775	...	"	30.1	14 43	4	7.2	7.1	10 1 82	7.2	9 29 86	7.2	11 14 86	7.25
2776	63	*Aquilæ*	30.2	7 18	3	5.4	5.4	10 1 82	5.4	9 21 86	5.4	9 26 88	5.4
2777	64	"	30.3	1 34	6	4.6	4.6	10 2 82	4.6	9 24 86	4.3	10 19 86	4.8
2778	212	*Sagittarii*	30.5	14 34	6	5.65	5.8	10 1 82	5.9	9 29 86	5.5	10 19 86	5.7
2779	213	"	30.8	14 14	3	6.95	7.0	10 1 82	6.9	9 29 86	7.0	9 26 88	7.0
2780	214	"	31.1	28 53	3	6.6	6.4	9 15 82	6.6	9 29 86	6.6	9 6 88	6.6
2781	65	*Aquilæ*	31.2	4 55	8	5.75	5.8	10 1 82	6.0	9 21 86	6.0	10 1 86	5.5
2782	66	"	31.9	10 26	2	6.7	6.8	10 1 82	6.7	9 21 86	6.7	.. .. ..	...
2783	...	*Sagittarii*	32.0	17 12	3	6.85	6.9	10 1 82	6.9	9 29 86	6.8	9 15 87	6.8
2784	217	"	32.3	23 43	5	6.7	6.7	9 15 82	6.9	9 29 86	6.8	9 15 87	6.7
2785	218	"	32.6	23 43	5	6.2	6.2	9 15 82	6.35	9 29 86	6.0	10 19 86	6.1
2786	219	"	32.8	15 27	4	6.8	6.8	10 1 82	6.9	9 29 86	6.8	9 15 87	6.65
2787	220	"	33.0	14 20	3	6.95	7.0	10 1 82	6.9	9 29 86	7.0	6 26 88	7.0
2788	221	"	33.6	16 35	4	5.55	5.5	10 1 82	5.4	9 29 86	5.6	9 15 87	5.55
2789	69	*Aquilæ*	33.7	5 44	3	6.9	6.9	10 1 82	6.9	9 21 86	6.85	9 27 88	6.9
2790	70	"	34.3	0 55	4	6.2	5.9	10 2 82	6.2	10 1 86	6.2	11 22 86	6.2
2791	223	*Sagittarii*	34.8	25 9	4	6.85	6.8	9 15 82	6.7	9 29 86	6.9	9 15 87	7.0
2792	71	*Aquilæ*	35.2	9 29	2	6.7	6.7	10 1 82	6.7	9 21 86	6.7	.. .. ..	...
2793	225	*Sagittarii*	35.4	16 25	4	5.35	5.4	10 1 82	5.3	9 29 86	5.3	9 15 87	5.3
2794	72	*Aquilæ*	36.3	8 36	3	6.7	6.7	10 1 82	6.7	9 21 86	6.7	9 26 88	6.7
2795	226	*Sagittarii*	36.4	15 46	5	5.75	5.8	10 1 82	5.7	9 29 86	5.8	9 15 87	5.85
2796	229	"	39.1	20 4	3	5.35	5.2	9 15 82	5.3	9 29 86	5.4	9 6 88	5.3
2797	76	*Aquilæ*	39.2	1 0	2	7.0	7.0	10 2 82	7.0	9 17 87	7.0	.. .. ..	...
2798	77	"	39.3	3 11	4	6.55	6.5	10 2 82	6.7	10 1 86	6.55	9 17 87	6.5
2799	230	*Sagittarii*	19 40.0	28 48	4	6.8	7.0	9 15 82	6.8	9 29 86	6.8	9 17 87	6.8

No.	U. A. No.	Name	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
2800	231	*Sagittarii*	19 40.6	−21 16	4	6.85	7.0	9 15 82	6.95	9 29 86	6.9	9 26 88	6.8
2801	232	"	41.0	14 1	3	6.3	6.3	10 1 82	6.3	9 24 86	6.2	9 26 88	6.4
2802	233	"	41.4	29 6	4	6.25	6.2	9 15 82	6.4	9 17 87	6.15	10 13 87	6.2
2803	234	"	41.9	12 38	4	7.05	7.0	10 1 82	7.1	9 17 87	7.1	9 26 88	7.0
2804	80	*Aquilæ*	42.2	11 11	3	6.35	6.4	10 1 82	6.3	9 24 86	6.4	9 26 88	6.35
2805	81	"	43.3	10 19	3	7.05	7.0	10 1 82	7.1	9 24 86	7.1	9 26 88	7.0
2806	82	"	43.9	11 5	4	5.7	5.8	10 1 82	5.6	9 24 86	5.6	9 26 88	5.85
2807	83	"	44.2	5 1	3	6.65	6.8	10 2 82	6.6	10 1 86	6.6	9 27 88	6.75
2808	239	*Sagittarii*	44.6	15 6	5	7.05	7.0	10 1 82	7.05	9 24 86	7.1	9 17 87	7.1
2809	85	*Aquilæ*	44.7	2 47	3	6.65	6.5	10 2 82	6.6	10 1 86	6.55	9 27 88	6.75
2810	238	*Sagittarii*	44.9	19 22	6	6.3	6.1	9 15 82	6.1	9 29 86	6.45	10 19 86	6.25
2811	...	*Aquilæ*	45.2	11 13	3	7.05	7.1	10 1 82	7.1	9 24 86	7.0	9 26 88	7.05
2812	89	"	46.1	+ 0 41	3	4.7	var.	9 24 86	4.7	9 17 87	4.65	9 26 88	4.7
2813	240	*Sagittarii*	46.1	−14 55	3	6.8	6.9	10 1 82	6.8	9 24 86	6.7	9 26 88	6.85
2814	242	"	46.8	24 15	3	6.3	6.4	9 15 82	6.35	9 29 86	6.3	11 14 86	6.3
2815	90	*Aquilæ*	46.8	3 26	2	5.9	5.9	10 2 82	5.9	10 1 86	5.9	.. .. ..	...
2816	92	"	47.4	8 54	3	6.25	6.2	10 1 82	6.1	9 21 86	6.35	9 26 88	6.35
2817	93	"	47.9	8 33	3	5.6	5.7	10 1 82	5.6	9 21 86	5.65	9 26 88	5.6
2818	247	*Sagittarii*	48.1	19 37	4	6.8	6.9	9 15 82	6.7	9 29 86	6.8	9 26 88	6.9
2819	248	"	48.2	26 38	8	4.95	5.1	9 15 82	4.95	9 29 86	4.95	10 3 86	5.0
2820	95	*Aquilæ*	48.3	0 3	4	5.8	5.9	10 2 82	5.7	9 17 87	5.9	10 12 87	5.9
2821	97	"	48.6	7 4	4	6.6	6.7	10 1 82	6.5	9 29 86	6.7	9 17 87	6.7
2822	250	*Sagittarii*	49.3	27 30	9	4.9	4.6	9 15 82	4.7	9 29 86	5.1	10 3 86	4.9
2823	99	*Aquilæ*	50.7	7 2	3	6.75	6.8	10 1 82	6.7	9 29 86	6.8	9 27 88	6.8
2824	253	*Sagittarii*	50.9	15 49	4	5.2	5.3	10 1 82	5.1	9 24 86	5.3	11 14 86	5.3
2825	255	"	51.3	26 32	8	5.2	5.3	9 15 82	5.3	9 29 86	5.2	10 3 86	5.15
2826	261	"	52.2	22 33	4	6.65	6.7	9 15 82	6.7	9 29 86	6.5	11 14 86	6.7
2827	100	*Aquilæ*	53.0	10 17	3	6.15	6.1	10 1 82	6.1	9 24 86	6.1	10 3 88	6.2
2828	102	"	53.2	2 18	5	6.95	7.0	10 2 82	7.1	10 1 86	6.85	9 17 87	6.8
2829	264	*Sagittarii*	54.0	23 5	4	6.05	5.9	9 15 82	6.1	9 29 86	6.1	11 14 86	6.05
2830	265	"	55.0	28 3	10	4.8	4.7	9 15 82	4.4	9 29 86	4.8	10 3 86	4.8
2831	266	"	55.0	13 59	3	5.9	5 7	10 1 82	5.9	9 24 86	5.9	9 26 88	5.85
2832	104	*Aquilæ*	55.6	5 20	5	6.7	6.7	10 1 82	6.7	9 26 86	6.7	10 1 86	6.95
2833	269	*Sagittarii*	56.3	22 57	4	6.45	6.5	9 15 82	6.35	9 29 86	6.5	11 14 86	6.5
2834	105	*Aquilæ*	57 3	7 49	2	6.8	6.9	10 1 82	6.8	9 29 86	6.8	.. .. ..	...
2835	273	*Sagittarii*	57.6	21 40	7	7.1	7.0	9 15 82	7.2	9 26 86	6.9	10 19 86	7.1
2836	106	*Aquilæ*	58 0	1 3	4	6.2	6 1	10 2 82	6.3	9 29 86	6.1	9 17 87	6.2
2837	108	"	58.2	11 57	5	6.6	6 6	10 1 82	6.5	9 24 86	6.7	9 17 87	6.5
2838	274	*Sagittarii*	58.5	13 1	4	6.7	6.7	10 1 82	6 65	9 24 86	6.75	9 26 88	6.7
2839	...	*Aquilæ*	59.0	4 40	3	7.4	..	9 16 87	7 4	9 27 88	7.35	10 3 88	7.5
2840	110	"	19 59.6	4 26	4	6.75	6.5	10 1 82	6.7	9 29 86	6.8	11 9 87	6.75
2841	...	"	20 0.0	4 46	4	6.9	...	9 16 87	6.9	10 17 87	6.9	9 27 88	6.9
2842	113	"	1.6	1 2	3	6.6	6.7	10 2 82	6.5	9 29 86	6.6	9 27 88	6.65
2843	...	"	1.4	7 7	3	7.0	...	10 1 82	7 0	9 29 86	6.95	9 27 89	7.0
2844	1	*Capricorni*	1.7	10 25	3	6.4	6.4	10 3 82	6.35	10 2 86	6.4	9 27 88	6.4
2845	116	*Aquilæ*	4.4	6 27	2	6.8	6.8	10 1 82	6.8	9 29 86	6.8	.. .. ..	...
2846	2	*Capricorni*	4.4	9 13	5	6.6	6.5	10 3 82	6.75	10 2 86	6.6	9 17 87	6.6
2847	117	*Aquilæ*	4 9	1 11	2	2.9	3.0	9 24 86	2.9	9 16 87	2.9	.. .. ..	...
2848	118	"	4.9	0 30	5	6.9	7.0	10 2 82	6 9	9 29 86	6.95	9 16 87	6.9
2849	3	*Capricorni*	5 0	12 46	5	6.75	6.8	10 2 82	6.6	9 24 86	6.7	9 26 88	6.85
2850	4	"	5.5	12 59	7	6 25	6.3	10 2 82	6 2	9 24 86	6.5	12 25 86	6.15
2851	119	*Aquilæ*	6.0	6 44	2	7 0	7 0	10 1 82	7.0	9 29 86	7.0	.. .. ..	...
2852	120	"	20 6.2	+ 0 30	3	6.5	6.6	10 2 82	6.5	9 29 86	6.5	9 27 88	6.55

No.	U. A. No.	Name.	1875. R A.		1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U.A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h.	m.	° ′									
2853	121	*Aquilæ*	20	6.3	− 3 22	4	6.95	7.0	10 2 82	6.95	9 29 86	6.8	9 16 87	7.05
2854	122	"		6.7	0 42	5	6.95	7.0	10 2 82	6.8	9 29 86	6.95	9 16 87	6.95
2855	123	"		6.8	1 23	3	5.9	5.8	10 2 82	5.9	9 29 86	5.95	9 27 88	5.8
2856	5	*Capricorni*		7.5	27 24	9	6.05	6.2	9 17 82	5.85	10 1 86	6.0	10 19 86	6.0
2857	124	*Aquilæ*		7.7	6 25	2	7.0	6.8	10 1 82	7.0	9 29 86	7.0	.. .. ..	...
2858	282	*Sagittarii*		8.1	30 23	4	6.55	6.5	9 17 82	6.6	10 1 86	6.5	10 19 86	6.5
2859	125	*Aquilæ*		8.6	3 53	3	6.8	6.8	10 2 82	6.85	9 29 86	6.75	9 27 88	6.75
2860	126	"		8.8	7 55	2	7.0	7.0	10 1 82	7.0	9 29 86	7.0	.. .. ..	...
2861	127	"		8.8	5 55	2	6.95	6.9	10 1 82	6.95	9 29 86	6.95	.. .. ..	...
2862	6	*Capricorni*		9.5	12 43	5	6.7	6.8	10 2 82	6.65	9 24 86	6.7	9 26 88	6.85
2863	...	*Aquilæ*		10.3	3 52	4	6.9	...	10 2 82	7.0	9 29 86	6.8	9 16 87	7.0
2864	7	*Capricorni*		10.7	22 12	5	6.15	6.1	10 3 82	6.1	10 1 86	6.25	9 17 87	6.3
2865	8	"		10.7	12 54	4	4.55	4.5	10 2 82	4.4	9 24 86	4.55	10 15 87	4.7
2866	9	"		11.1	12 56	3	3.7	3.6	10 2 82	3.7	9 24 86	3.6	9 26 88	3.75
2867	10	"		12.1	21 20	3	6.85	6.9	10 3 82	6.8	10 1 86	6.85	9 27 88	6.9
2868	11	"		12.2	19 30	10	5.8	5.6	10 2 82	5.6	9 21 86	5.9	10 1 86	5.5
2869	130	*Aquilæ*		12.2	+ 0 15	3	6.95	6.9	10 2 82	6.9	9 29 86	6.95	9 27 88	6.95
2870	289	*Sagittarii*		12.8	−29 35	3	6.3	6.2	9 17 82	6.3	10 1 86	6.3	10 19 86	6.25
2871	131	*Aquilæ*		13.3	1 28	4	6.4	6.4	10 2 82	6.5	9 29 86	6.4	9 27 88	6.35
2872	12	*Capricorni*		13.7	13 9	6	5.15	5.2	10 2 82	5.3	9 24 86	5.15	9 17 87	5.2
2873	13	"		13.8	15 11	6	6.9	6.7	10 2 82	7.1	9 24 86	6.85	12 25 86	7.05
2874	14	"		14.0	15 11	3	3.15	3.2	10 2 82	3.2	9 24 86	3.1	9 26 88	3.1
2875	15	"		16.2	10 3	3	6.75	6.9	10 3 82	6.75	10 2 86	6.8	9 27 88	6.75
2876	16	"		16.5	14 39	2	6.8	6.8	10 2 82	6.8	9 24 86	6.8	.. .. ..	...
2877	133	*Aquilæ*		17.0	5 40	3	6.85	7.0	10 2 82	6.8	9 29 86	7.0	9 16 87	6.8
2878	...	*Capricorni*		17.3	14 31	3	7.1	7.1	10 2 82	7.1	9 24 86	7.0	10 12 87	7.2
2879	296	*Sagittarii*		17.8	29 4	4	6.25	6.1	9 17 82	6.3	9 14 84	6.2	10 1 86	6.3
2880	135	*Aquilæ*		18.3	+ 0 40	6	6.25	6.4	10 2 82	6.5	9 29 86	6.1	9 16 87	6.15
2881	136	"		18.3	0 58	3	6.9	6.7	10 2 82	6.9	9 29 86	6.95	9 27 88	6.9
2882	137	"		19.2	3 12	4	6.45	6.6	10 2 82	6.4	9 14 84	6.5	10 1 86	6.45
2883	17	*Capricorni*		20.2	−18 37	6	5.55	5.5	10 2 82	5.6	9 21 86	5.5	9 24 86	5.6
2884	18	"		20.5	26 1	3	6.65	6.6	10 3 82	6.6	10 1 86	6.7	9 27 88	6.7
2885	138	*Aquilæ*		21.0	2 31	4	6.6	6.5	10 2 82	6.6	9 14 84	6.7	10 1 86	6.6
2886	...	*Capricorni*		21.1	24 34	4	7.1	7.2	10 3 82	7.2	10 1 86	7.0	10 13 87	7.0
2887	19	"		21.3	24 24	3	7.0	6.9	10 3 82	7.0	10 1 86	7.0	9 27 88	7.0
2888	20	"		21.7	16 9	5	6.9	6.8	10 3 82	6.9	10 2 86	6.7	9 17 87	6.65
2889	22	"		21.7	18 14	6	5.25	5.3	10 2 82	5.2	9 21 86	5.4	9 24 86	5.3
2890	21	"		21.7	21 19	3	6.9	7.0	10 3 82	6.9	10 1 86	6.95	9 27 88	6.9
2891	...	"		21.9	12 8	4	7.2	7.1	10 3 82	7.0	10 2 86	7.15	9 27 88	7.25
2892	139	*Aquilæ*		21.9	3 46	5	6.15	6.3	10 2 82	6.3	9 14 84	6.1	10 1 86	6.1
2893	23	*Capricorni*		21.9	18 17	4	7.0	7.0	10 2 82	7.1	10 2 86	7.1	9 17 87	6.95
2894	24	"		22.2	22 48	4	6.6	6.5	10 3 82	6.6	10 1 86	6.7	10 13 87	6.55
2895	140	*Aquilæ*		22.3	2 9	4	7.0	6.9	10 2 82	7.0	9 14 84	6.9	10 1 86	7.1
2896	25	*Capricorni*		22.7	19 0	5	5.85	5.9	10 2 82	5.9	9 21 86	5.8	9 24 86	5.9
2897	141	*Aquilæ*		23.1	3 18	4	5.15	5.3	9 14 84	5.2	10 1 86	5.05	9 16 87	5.05
2898	3	*Microscopium*		23.3	29 32	5	6.55	6.5	9 17 82	6.5	9 14 84	6.4	10 1 86	6.8
2899	26	*Capricorni*		23.6	12 39	4	7.5	var.	10 19 86	7.5	10 22 86	7.5	10 18 89	7.4
2900	27	"		24.1	15 28	3	6.45	6.4	10 3 82	6.5	10 2 86	6.45	10 13 87	6.45
2901	5	*Microscopium*		25.1	29 1	5	7.0	7.0	9 14 82	7.1	9 17 82	7.1	10 1 86	6.8
2902	28	*Capricorni*		25.4	25 22	3	6.4	6.4	10 3 82	6.4	10 1 86	6.35	9 27 88	6.5
2903	29	"		25.6	10 17	4	6.0	6.0	10 3 82	5.85	10 2 86	6.0	9 17 87	6.1
2904	7	*Microscopium*		26.2	29 43	4	6.95	7.0	9 17 82	6.85	9 14 84	7.0	10 1 86	6.85
2905	30	*Capricorni*	20	27.1	12 46	5	6.95	7.0	10 3 82	7.0	10 2 86	6.9	11 18 86	7.0

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2906	10	*Microscopium*	20 27.1	−30 54	3	6.5	6.4	9 14 84	6.4	10 1 86	6.55	9 16 87	6.5
2907	31	*Capricorni*	27.2	14 9	4	6.4	6.3	10 3 82	6.5	10 2 86	6.3	9 17 87	6.45
2908	143	*Aquilæ*	27.9	6 16	5	6.95	7.0	10 2 86	6.8	9 16 87	7.05	11 2 87	6.9
2909	32	*Capricorni*	28.5	16 57	9	6.3	6.5	10 3 82	6.2	10 2 86	6.5	10 19 86	6.1
2910	33	"	29.4	12 49	4	7.0	6.8	10 3 82	7.0	10 2 86	7.0	11 27 86	7.0
2911	144	*Aquilæ*	30.2	2 59	5	5.4	5.1	9 14 84	5.5	10 1 86	5.4	10 2 86	5.2
2912	34	*Capricorni*	30.3	15 35	2	7.0	7.0	10 3 82	7.0	11 27 86	7.0	.. .. ..	...
2913	35	"	30.4	25 33	5	6.6	6.6	10 3 82	6.6	10 1 86	6.5	11 18 86	6.8
2914	36	"	30.7	24 40	3	6.8	6.8	10 3 82	6.8	10 1 86	6.7	9 27 88	6.85
2915	37	"	30.7	17 33	4	7.05	7.0	10 3 82	7.0	10 2 86	7.1	9 17 87	7.05
2916	145	*Aquilæ*	30.9	0 20	6	6.4	6.4	9 14 84	6.3	10 2 86	6.3	9 27 88	6.4
2917	38	*Capricorni*	31.1	11 28	3	7.0	7.0	10 3 82	7.0	10 2 86	7.0	11 27 86	7.0
2918	...	*Aquilæ*	31.6	4 49	4	7.3	7.1	9 14 84	7.1	9 16 87	7.4	11 9 87	7.4
2919	146	"	31.9	1 32	3	4.55	4.5	9 14 84	4.5	10 2 86	4.5	10 25 88	4.6
2920	39	*Capricorni*	32.3	15 24	5	5.6	5.6	10 2 82	5.7	9 21 86	5.55	9 17 87	5.6
2921	1	*Aquarii*	32.5	5 22	3	6.9	6.8	10 4 82	6.9	10 2 86	6.8	9 27 88	6.95
2922	2	"	32.7	2 51	3	6.55	6.5	10 4 82	6.5	10 2 86	6.6	9 27 88	6.6
2923	40	*Capricorni*	32.8	24 14	3	6.7	6.5	10 3 82	6.7	10 1 86	6.65	9 27 88	6.7
2924	41	"	32.9	18 35	5	5.8	5.7	10 2 82	5.6	10 2 86	5.75	9 17 87	5.9
2925	3	*Aquarii*	33.0	+ 0 3	5	5.55	5.6	9 14 84	5.7	10 1 86	5.6	10 2 86	5.6
2926	42	*Capricorni*	33.1	−27 5	4	6.65	6.7	9 16 82	6.7	10 1 86	6.65	9 27 88	6.6
2927	16	*Microscopium*	33.3	28 59	3	6.9	6.9	9 14 84	6.9	10 1 86	6.9	9 27 88	6.95
2928	43	*Capricorni*	33.5	16 34	4	6.15	6.2	10 3 82	6.2	9 21 86	6.1	10 2 86	6.1
2929	4	*Aquarii*	33.7	3 6	5	7.0	7.0	10 4 82	6.9	9 21 84	7.0	10 2 86	7.15
2930	...	"	34.7	12 5	5	6.85	7.1	10 4 82	6.8	10 2 86	6.9	11 27 86	6.9
2931	44	*Capricorni*	33.9	26 27	4	6.65	6.6	9 16 82	6.7	10 1 86	6.65	9 27 88	6.6
2932	5	*Aquarii*	34.9	11 23	5	7.6	7.0	10 4 82	6.95	10 2 86	7.3	9 18 87	8.0
2933	6	"	36.0	2 46	5	7.3	7.0	10 4 82	7.0	10 2 86	7.15	9 18 87	7.3
2934	20	*Microscopium*	35.7	29 52	3	6.95	6.9	9 14 84	7.0	10 1 86	6.9	9 27 88	6.95
2935	45	*Capricorni*	37.7	27 42	3	6.7	6.7	9 16 82	6.7	10 1 86	6.7	9 27 88	6.7
2936	22	*Microscopium*	37.7	30 56	3	6.75	6.9	9 14 84	6.7	10 1 86	6.8	9 27 88	6.75
2937	46	*Capricorni*	38.2	16 15	4	6.9	7.0	10 3 82	7.0	10 2 86	6.85	11 18 86	6.8
2938	47	"	38.7	25 43	10	4.15	4.3	9 16 82	4.2	10 1 86	4.1	10 2 86	4.7
2939	48	"	38.9	21 58	2	6.0	6.0	10 3 82	6.0	10 1 86	6.0	.. .. ..	...
2940	49	"	39.0	27 19	3	6.85	7.0	9 16 82	6.9	10 1 86	6.8	9 27 88	6.85
2941	7	*Aquarii*	40.6	2 57	2	6.8	6.7	10 4 82	6.8	10 2 86	6.8	.. .. ..	...
2942	8	"	40.9	9 57	4	3.9	3.8	10 2 82	4.0	9 24 86	4.0	9 28 88	3.7
2943	9	"	41.1	5 29	4	4.8	4.8	9 14 84	4.7	10 2 86	4.8	9 27 88	4.85
2944	50	*Capricorni*	41.1	19 43	3	6.8	6.9	10 3 82	6.8	10 2 86	6.8	9 27 88	6.8
2945	51	"	41.2	16 59	4	7.0	7.0	10 3 82	6.9	10 2 86	6.95	9 28 88	7.1
2946	...	"	41.3	18 40	3	6.9	6.9	10 3 82	6.85	10 2 86	6.95	9 27 88	6.95
2947	52	"	41.9	26 14	8	6.0	6.1	9 16 82	5.9	10 1 86	6.2	10 19 86	5.9
2948	53	"	42.3	18 30	5	6.6	6.7	10 3 82	6.5	10 2 86	6.65	9 17 87	6.6
2949	54	"	43.1	25 27	2	6.9	6.9	9 16 82	6.9	10 1 86	6.9	.. .. ..	...
2950	11	*Aquarii*	43.8	13 0	4	6.3	6.2	10 4 82	6.3	10 2 86	6.3	10 20 86	6.1
2951	55	*Capricorni*	44.1	27 43	2	6.9	6.8	9 16 82	6.9	10 1 86	6.9	.. .. ..	...
2952	30	*Microscopium*	44.1	28 28	5	6.8	6.8	9 14 84	6.8	10 1 86	6.8	11 26 86	6.8
2953	31	"	44.1	29 54	3	6.95	6.9	9 14 84	7.0	10 1 86	6.95	9 27 88	6.95
2954	56	*Capricorni*	44.4	27 23	7	4.4	4.1	9 16 82	4.5	10 1 86	4.4	10 19 86	4.3
2955	12	*Aquarii*	44.8	6 6	4	6.1	6.2	10 4 82	6.1	10 2 86	6.0	11 24 86	6.05
2956	57	*Capricorni*	45.1	20 7	3	6.85	6.9	10 3 82	6.85	10 2 86	6.8	9 27 88	6.95
2957	14	*Aquarii*	45.2	11 54	3	6.85	7.0	10 4 82	6.8	10 2 86	6.9	9 27 88	6.8
2958	13	"	20 45.5	5 59	3	5.65	5.8	10 4 82	5.7	10 2 86	5.65	9 27 88	5.65

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2959	58	*Capricorni*	20 45.7	−24 15	5	6.55	6.6	9 16 82	6.5	10 1 86	6.65	9 17 87	6.5
2960	34	*Microscopium*	45.8	31 11	3	6.7	6.7	9 14 84	6.6	10 1 86	6.7	9 28 88	6.85
2961	16	*Aquarii*	45.9	9 27	4	4.9	5.0	10 2 82	5.0	9 24 86	4.9	9 27 88	4.85
2962	15	"	46.3	12 3	4	6.65	6.8	10 4 82	6.6	10 2 86	6.6	9 27 88	6.8
2963	59	*Capricorni*	46.4	19 35	3	6.9	6.9	10 3 82	6.85	10 2 86	6.9	9 27 88	6.95
2964	35	*Microscopium*	46.6	28 24	5	6.7	6.7	9 14 84	6.7	10 1 86	6.75	11 26 86	6.65
2965	17	*Aquarii*	47.3	11 24	6	7.0	7.0	10 4 82	7.1	10 2 86	6.9	9 18 87	7.05
2966	18	"	47.3	7 22	4	6.65	6.7	10 4 82	6.6	10 2 86	6.8	9 18 87	6.6
2967	19	"	47.5	5 1	3	6.85	6.9	10 4 82	6.9	10 2 86	6.8	11 24 86	6.85
2968	60	*Capricorni*	47.7	19 16	3	6.65	6.8	10 3 82	6.65	10 2 86	6.65	9 27 88	6.6
2969	61	"	47.7	18 24	8	6.3	6.1	10 3 82	6.2	10 2 86	6.4	10 19 86	6.45
2970	20	*Aquarii*	48.1	9 21	6	7.0	6.9	10 4 82	7.1	10 2 86	7.0	9 18 87	7.05
2971	21	"	48.7	1 51	4	6.45	6.5	10 4 82	6.4	10 2 86	6.4	9 28 88	6.55
2972	62	*Capricorni*	48.8	17 35	2	7.0	7.0	10 3 82	7.0	10 2 86	7.0	.. .. ..	...
2973	...	"	49.1	17 43	3	7.3	7.2	10 3 82	7.3	10 2 86	7.2	9 27 88	7.35
2974	63	"	49.4	26 46	6	6.0	6.1	9 16 82	5.9	10 1 86	6.0	11 18 86	6.1
2975	23	*Aquarii*	49.8	4 2	3	6.55	6.5	10 4 82	6.6	10 2 86	6.5	9 28 88	6.55
2976	...	"	50.2	4 9	3	7.4	7.3	10 4 82	7.3	12 17 86	7.45	9 28 88	7.4
2977	24	"	50.2	10 11	4	5.95	5.9	10 4 82	5.9	10 2 86	6.0	10 13 87	5.85
2978	64	*Capricorni*	50.7	16 31	7	6.1	5.9	10 3 82	6.1	10 2 86	5.75	10 19 86	6.15
2979	26	*Aquarii*	50.8	0 1	2	6.2	6.2	10 4 82	6.2	10 2 86	6.2	.. .. ..	...
2980	27	"	51.8	14 58	5	6.1	6.1	10 4 82	6.3	10 2 86	6.1	11 24 86	6.05
2981	28	"	52.2	4 20	3	7.0	7.0	10 4 82	7.0	10 2 86	7.0	11 24 86	7.05
2982	65	*Capricorni*	52.5	19 31	3	6.35	6.3	10 3 82	6.4	10 2 86	6.3	9 27 88	6.3
2983	29	*Aquarii*	53.1	13 32	4	6.8	6.8	10 4 82	6.8	10 2 86	6.8	9 28 88	6.8
2984	38	*Microscopium*	53.5	30 13	2	6.8	7.0	9 14 84	6.8	10 1 86	6.8	.. .. ..	...
2985	66	*Capricorni*	53.8	18 1	3	6.55	6.4	10 3 82	6.5	10 2 86	6.6	9 27 88	6.6
2986	30	*Aquarii*	54.0	5 58	5	6.35	6.4	10 4 82	6.5	10 2 86	6.2	11 24 86	6.35
2987	31	"	54.0	5 13	4	6.35	6.2	10 4 82	6.3	10 2 86	6.4	11 24 86	6.45
2988	32	"	54.3	14 1	6	6.8	6.8	10 4 82	6.6	10 2 86	6.8	9 18 87	6.85
2989	67	*Capricorni*	54.3	27 22	6	6.25	6.2	9 16 82	6.1	10 1 86	6.3	11 18 86	6.5
2990	33	*Aquarii*	55.2	12 11	4	7.1	7.0	10 4 82	7.1	10 2 86	7.05	9 18 87	7.1
2991	45	*Microscopium*	55.4	29 36	3	6.95	6.9	9 14 84	7.0	10 1 86	6.9	9 28 88	6.95
2992	46	"	55.7	28 13	4	6.6	6.6	9 14 84	6.5	10 1 86	6.6	11 26 86	6.65
2993	34	*Aquarii*	56.6	1 25	3	6.6	6.5	10 4 82	6.6	10 2 86	6.6	9 29 88	6.55
2994	...	"	56.7	1 48	3	7.15	7.2	10 4 82	7.2	10 2 86	7.1	12 20 86	7.1
2995	36	"	57.0	2 4	3	7.0	6.9	10 4 82	7.0	10 2 86	7.05	9 18 87	6.9
2996	...	"	57.0	2 49	3	7.0	...	9 18 87	6.9	10 12 87	7.1	9 29 88	7.0
2997	68	*Capricorni*	57.3	20 21	7	5.05	5.1	9 16 82	5.2	10 1 86	5.05	10 2 86	5.0
2998	37	*Aquarii*	57.5	6 19	3	5.8	5.7	10 4 82	5.8	10 2 86	5.75	9 28 88	5.9
2999	69	*Capricorni*	57.8	17 40	3	7.15	7.0	10 3 82	7.1	10 2 86	7.1	9 28 88	7.2
3000	48	*Microscopium*	58.5	30 37	3	6.15	6.0	9 14 84	6.2	10 1 86	6.1	9 28 88	6.2
3001	70	*Capricorni*	58.9	17 44	6	3.9	4.1	9 16 82	4.0	10 1 86	3.85	10 2 86	3.9
3002	71	"	59.6	20 41	2	6.9	6.9	9 16 82	6.9	10 2 86	6.9	.. .. .	...
3003	73	"	20 59.8	25 30	8	4.85	4.8	9 16 82	5.0	10 1 86	4.8	10 22 86	4.6
3004	...	*Aquarii*	21 0.2	0 36	3	7.15	7.2	10 4 82	7.2	10 2 86	7.1	10 15 87	7.15
3005	74	*Capricorni*	0.4	19 35	3	7.0	6.9	9 16 82	7.0	10 2 86	6.95	9 29 88	7.0
3006	75	"	0.7	17 58	3	6.45	6.6	10 3 82	6.4	10 2 86	6.5	9 29 88	6.5
3007	40	*Aquarii*	0.8	8 44	4	6.8	6.7	10 4 82	6.9	10 20 86	6.7	9 18 87	6.8
3008	41	"	0.9	1 16	3	6.85	6.8	10 4 82	6.8	10 2 86	6.9	9 29 88	6.9
3009	39	"	1.1	0 40	6	7.1	7.0	10 4 82	6.9	11 24 86	7.15	10 20 86	7.1
3010	42	"	1.2	2 33	3	6.85	6.9	10 4 82	6.8	10 2 86	6.9	9 29 88	6.8
3011	76	*Capricorni*	21 1.4	21 42	6	5.4	5.4	9 16 82	5.4	10 1 86	5.4	10 2 86	5.4

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3012	44	*Aquarii*	21 1.7	– 1 30	3	6.9	7.0	10 4 82	6.9	10 2 86	6.9	9 29 88	6.9
3013	77	*Capricorni*	2.1	20 42	4	6.95	7.0	9 16 82	7.0	10 2 86	6.85	9 18 87	6.9
3014	45	*Aquarii*	2.4	6 5	4	6.9	7.0	10 4 82	6.8	10 2 86	7.0	9 18 87	6.95
3015	78	*Capricorni*	2.4	21 3	3	6.55	6.5	9 16 82	6.6	10 2 86	6.6	10 10 88	6.5
3016	54	*Microscopium*	2.6	30 14	3	6.95	6.9	9 14 84	7.0	10 1 86	6.9	9 29 88	6.95
3017	47	*Aquarii*	2.8	11 53	2	4.7	4.7	10 2 82	4.7	11 24 86	4.7	.. .. ..	...
3018	48	"	2.8	0 44	3	6.8	6.7	10 4 82	6.8	10 2 86	6.85	9 29 88	6.7
3019	49	"	4.0	9 52	3	6.6	6.5	10 4 82	6.6	10 20 86	6.6	10 25 88	6.55
3020	50	"	4.8	14 59	5	6.6	6.5	10 3 82	6.8	10 2 86	6.55	12 17 86	6.5
3021	58	*Microscopium*	5.9	28 8	4	5.85	5.8	9 16 82	5.9	9 14 84	5.8	10 1 86	5.8
3022	51	*Aquarii*	7.5	11 7	5	6.7	6.8	10 4 82	6.6	10 20 86	6.6	9 29 88	6.75
3023	79	*Capricorni*	8.1	17 52	13	6.5	6.4	10 3 82	6.2	12 25 86	6.75	9 18 87	6.7
3024	52	*Aquarii*	8.2	0 25	3	6.85	6.8	10 4 82	6.8	10 2 86	6.85	9 29 88	6.85
3025	...	"	8.5	3 5	5	7.0	...	10 4 82	7.0	10 2 86	6.9	10 15 87	7.0
3026	80	*Capricorni*	8.5	21 10	6	5.6	5.5	9 16 82	5.65	10 1 86	5.5	10 2 86	5.65
3027	81	"	8.8	15 41	3	5.85	5.7	10 3 82	5.9	9 18 87	5.75	10 13 87	5.95
3028	...	*Aquarii*	9.1	9 38	2	7.4	7.3	10 4 82	7.4	10 20 86	7.4	.. .. ..	...
3029	53	"	9.2	13 43	3	6.95	6.9	10 3 82	7.0	10 2 86	6.9	9 29 88	6.95
3030	54	"	9.6	9 44	2	6.6	6.6	10 4 82	6.6	10 20 86	6.6	.. .. ..	...
3031	55	"	10.2	2 8	3	6.85	6.9	10 4 82	6.9	10 2 86	6.85	9 29 88	6.85
3032	56	"	10.2	10 39	2	6.8	6.9	10 4 82	6.8	10 20 86	6.8	.. .. ..	...
3033	57	"	10.4	13 48	3	6.55	6.5	10 3 82	6.5	10 2 86	6.6	9 29 88	6.55
3034	82	*Capricorni*	11.0	18 30	4	5.45	5.5	9 16 82	5.5	10 2 86	5.4	9 29 88	5.5
3035	83	"	11.4	20 51	3	6.95	7.0	9 16 82	6.9	10 2 86	6.95	9 29 88	6.95
3036	64	*Microscopium*	11.5	29 17	3	6.55	6.5	9 14 84	6.5	10 1 86	6.6	9 29 88	6.55
3037	58	*Aquarii*	11.6	5 3	4	5.7	5.8	10 4 82	5.8	10 2 86	5.6	9 18 87	5.7
3038	84	*Capricorni*	12.5	27 44	5	6.8	6.9	9 16 82	6.85	10 1 86	6.6	9 18 87	6.8
3039	85	"	12.5	26 52	3	6.8	6.7	9 16 82	6.85	10 1 86	6.85	9 29 88	6.75
3040	59	*Aquarii*	13.0	14 33	3	6.95	7.0	10 3 82	6.95	10 2 86	6.9	9 29 88	6.95
3041	60	"	13.2	13 31	3	6.9	6.9	10 3 82	6.95	10 2 86	6.9	9 29 88	6.9
3042	61	"	13.3	14 2	3	6.95	7.0	10 3 82	6.95	10 2 86	6.9	9 29 88	7.0
3043	66	*Microscopium*	14.4	29 42	5	6.7	6.7	9 14 84	6.6	10 1 86	6.85	9 18 87	6.8
3044	62	*Aquarii*	14.5	5 5	2	6.1	6.1	10 4 82	6.1	10 2 86	6.1	.. .. ..	...
3045	86	*Capricorni*	15.3	17 22	8	4.4	4.4	9 16 82	4.35	10 1 86	4.35	10 2 86	4.4
3046	64	*Aquarii*	15.3	9 51	2	6.9	6.9	10 4 82	6.9	10 20 86	6.9	.. .. ..	..
3047	63	"	15.5	+ 0 50	4	7.0	6.8	9 17 84	6.9	10 2 86	6.8	10 24 88	7.2
3048	87	*Capricorni*	15.8	–23 12	6	6.1	6.0	9 16 82	6.1	10 1 86	6.05	11 18 86	6.15
3049	66	*Aquarii*	16.0	3 40	4	6.7	6.9	10 4 82	6.75	10 2 86	6.75	9 29 88	6.65
3050	65	"	16.2	9 51	4	6.35	6.2	10 4 82	6.3	10 20 86	6.4	9 29 88	6.45
3051	88	*Capricorni*	16.7	25 44	5	6.8	6.8	9 16 82	6.6	10 2 86	6.8	9 18 87	6.8
3052	89	"	17.0	23 17	8	6.65	6.8	9 16 82	6.4	10 1 86	6.6	10 19 86	6.6
3053	90	"	17.1	21 23	5	5.8	5.7	9 16 82	5.8	10 1 86	5.75	11 22 86	5.65
3054	91	"	17.1	24 57	3	6.8	6.8	9 16 82	6.85	10 2 86	6.85	9 29 88	6.75
3055	67	*Aquarii*	17.4	13 25	4	5.6	5.7	10 3 82	5.7	10 2 86	5.5	9 18 87	5.6
3056	69	"	18.4	3 56	3	6.55	6.5	10 4 82	6.6	10 2 86	6.5	9 29 88	6.55
3057	68	"	18.5	10 17	4	5.8	5.8	10 4 82	5.65	10 20 86	5.75	9 29 88	5.9
3058	92	*Capricorni*	18.6	24 22	4	6.8	6.8	9 16 82	6.7	10 2 86	6.8	11 22 86	6.9
3059	71	*Aquarii*	18.6	14 49	6	6.7	6.8	10 3 82	6.8	12 17 86	6.55	12 20 86	6.6
3060	70	"	18.8	4 5	4	5.65	5.7	10 4 82	5.55	10 2 86	5.8	12 17 86	5.7
3061	72	"	19.5	0 0	4	6.5	6.4	9 17 84	6.4	10 2 86	6.55	9 18 87	6.55
3062	93	*Capricorni*	19.5	22 57	6	3.85	3.7	9 16 82	3.7	10 1 86	3.9	10 22 86	3.9
3063	73	*Aquarii*	19.6	12 38	4	6.95	7.0	10 3 82	6.95	10 2 86	6.9	11 28 86	6.9
3064	74	"	21 20.1	+ 0 34	2	6.3	6.2	9 17 84	6.3	10 2 86	6.3	.. .. ..	...

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd	Mag. U. A	Separate Observations. Date.	Mag	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
3065	94	*Capricorni*	21 20.2	−21 44	6	6.3	6.2	9 16 82	6.2	10 1 86	6.3	10 2 86	6.3
3066	95	"	20.6	14 8	4	6.85	6.8	10 3 82	6.8	10 2 86	6.9	11 18 86	6.9
3067	96	"	20.9	12 12	4	7.05	7.0	10 3 82	7.1	10 2 86	7.0	10 13 87	7.2
3068	97	"	21.5	12 7	3	6.8	6.8	10 3 82	6.8	10 2 86	6.8	9 29 88	6.8
3069	98	"	21.6	22 21	5	4.75	4.7	9 16 82	4.9	10 1 86	4.8	11 26 86	4.75
3070	1	*Piscis Austrini*	21.6	31 47	4	6.5	6.5	9 14 84	6.6	10 2 86	6.5	9 29 88	6.4
3071	99	*Capricorni*	22.8	14 34	5	7.0	7.0	10 3 82	6.95	10 2 86	7.0	11 18 86	7.0
3072	100	"	23.0	19 42	3	6.7	6.6	9 16 82	6.7	10 2 86	6.8	9 29 88	6.6
3073	101	"	23.8	14 50	3	6.8	6.8	10 3 82	6.8	10 2 86	6.8	9 29 88	6.8
3074	102	"	24.4	19 47	4	7.0	7.0	9 16 82	6.9	10 2 86	7.0	9 29 88	7.15
3075	75	*Aquarii*	25.0	6 7	9	2.8	2.6	10 2 82	2.7	9 21 84	2.9	9 26 84	2.55
3076	103	*Capricorni*	25.4	25 9	3	6.5	6.5	9 16 82	6.5	10 21 86	6.55	9 29 88	6.45
3077	104	"	25.6	12 49	7	7.0	7.0	10 3 82	6.6	10 2 86	6.9	11 18 86	7.0
3078	76	*Aquarii*	27.0	1 23	3	6.65	6.8	9 17 84	6.7	10 2 86	6.65	9 29 88	6.6
3079	3	*Piscis Austrini*	27.5	30 15	2	6.4	6.4	9 14 84	6.4	10 2 86	6.4	.. .. ..	...
3080	77	*Aquarii*	27.6	4 55	4	6.8	6.7	10 4 82	6.75	10 2 86	6.8	9 29 88	6.9
3081	78	"	27.8	3 58	3	6.8	6.8	10 4 82	6.8	10 2 86	6.75	9 29 88	6.9
3082	105	*Capricorni*	27.8	20 38	2	6.0	6.0	9 16 82	6.0	10 2 86	6.0	.. .. ..	...
3083	106	"	27.9	20 48	4	6.7	6.9	9 16 82	6.7	10 2 86	6.65	9 18 87	6.7
3084	107	"	28.1	24 1	5	6.6	6.7	9 16 82	6.5	10 2 86	6.7	9 18 87	6.65
3085	79	*Aquarii*	28.4	+ 1 17	3	6.85	6.7	9 17 84	6.8	12 17 86	6.9	9 29 88	6.9
3086	80	"	28.8	− 4 32	3	6.25	6.2	10 4 82	6.3	10 2 86	6.2	9 29 88	6.3
3087	5	*Piscis Austrini*	28.9	26 44	3	6.05	6.0	9 14 84	6.0	12 25 86	6.1	9 29 88	6.0
3088	108	*Capricorni*	30.1	20 2	4	4.6	4.7	9 16 82	4.6	10 1 86	4.6	11 26 86	4.6
3089	...	"	30.7	19 48	6	7.35	7.1	9 16 82	7.4	10 2 86	7.2	10 19 86	7.4
3090	81	*Aquarii*	31.1	8 25	2	5.0	5.0	9 16 82	5.0	11 24 86	5.0	.. .. ..	...
3091	82	"	31.2	0 57	3	6.1	6.2	9 17 84	6.1	10 2 86	6.05	9 29 88	6.15
3092	9	*Piscis Austrini*	31.9	27 52	3	6.85	6.8	9 14 84	6.9	10 2 86	6.8	9 29 88	6.9
3093	109	*Capricorni*	32.8	11 8	3	6.45	6.3	9 16 82	6.45	10 2 86	6.5	9 29 88	6.45
3094	83	*Aquarii*	33.1	0 37	4	6.7	6.7	9 17 84	6.6	10 2 86	6.65	9 29 88	6.8
3095	110	*Capricorni*	33.2	17 14	6	3.6	3.7	9 16 82	3.5	10 1 86	3.6	10 2 86	3.5
3096	84	*Aquarii*	33.2	+ 1 41	3	5.55	5.5	9 17 84	5.6	10 2 86	5.5	10 15 87	5.5
3097	12	*Piscis Austrini*	34.6	− 25 40	4	6.8	6.8	9 14 84	6.7	10 2 86	6.8	9 29 88	6.9
3098	111	*Capricorni*	34.8	14 36	6	5.55	5.6	9 16 82	5.45	10 2 86	5.6	9 15 87	5.55
3099	112	"	34.9	23 50	3	5.7	5.8	9 16 82	5.7	9 14 84	5.7	10 2 86	5.75
3100	113	"	35.7	19 26	5	5.1	5.0	9 16 82	5.2	10 1 86	5.1	11 26 86	5.1
3101	85	*Aquarii*	35.8	+ 0 43	5	5.95	6.0	9 17 84	5.9	10 2 86	6.05	9 18 87	5.9
3102	114	*Capricorni*	36.2	−20 11	4	6.4	6.3	9 16 82	6.35	10 2 86	6.3	9 29 88	6.5
3103	115	"	36.3	14 58	5	6.1	6.1	9 16 82	6.0	10 2 86	6.1	9 18 87	6.2
3104	116	"	37.2	15 19	3	6.2	6.3	9 16 82	6.2	10 2 86	6.15	9 30 88	6.25
3105	86	*Aquarii*	37.9	5 18	3	6.8	6.7	10 10 82	6.8	10 20 86	6.8	9 29 88	6.8
3106	117–8	*Capricorni*	38.3	9 39	4	5.35	5.4	9 16 82	5.45	10 2 86	5.3	9 15 87	5.3
3107	119	"	38.6	13 21	4	6.7	6.7	9 16 82	6.8	10 2 86	6.7	9 29 88	6.7
3108	120	"	39.6	9 51	4	6.5	6.4	9 16 82	6.45	10 2 86	6.6	9 18 87	6.55
3109	121	"	39.8	11 57	4	5.75	5.7	9 16 82	5.75	10 2 86	5.7	9 29 88	5.75
3110	122	"	40.0	12 16	7	7.0	6.9	9 16 82	7.2	10 2 86	7.0	11 18 86	7.0
3111	123	"	40.1	16 42	8	2.65	2.8	10 2 82	2.4	10 1 86	2.9	10 2 86	2.65
3112	87	*Aquarii*	40.1	2 48	7	7.0	6.8	10 10 82	7.0	10 20 86	7.0	11 18 86	7.1
3113	...	"	40.6	2 52	5	7.4	7.5	10 10 82	7.3	10 20 86	7.4	9 29 88	7.35
3114	88	"	40.9	5 11	2	6.9	6.8	10 10 82	6.9	10 20 86	6.9	.. .. ..	...
3115	89	"	41.1	6 30	3	6.35	6.5	10 10 82	6.4	10 20 86	6.35	9 29 88	6.35
3116	90	"	42.5	5 59	2	6.9	6.9	10 10 82	6.9	10 20 86	6.9	.. .. ..	...
3117	17	*Piscis Austrini*	21 42.7	27 59	2	7.0	7.0	9 14 84	7.0	10 2 86	7.0	.. .. ..	...

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			h. m.	° ′									
3118	124	*Capricorni*	21 42.9	−13 18	6	6.45	6.3	9 16 82	6.45	10 2 86	6.3	9 18 87	6.4
3119	125	"	43.3	17 26	2	6.6	6.5	9 16 82	6.6	10 2 86	6.6	.. .. ..	...
3120	126	"	43.9	9 34	3	6.85	6.8	9 16 82	6.8	10 2 86	6.9	9 29 88	6.9
3121	...	*Aquarii*	44.2	+ 0 10	3	7.45	7.5	10 20 86	7.4	9 18 87	7.5	10 15 87	7.5
3122	127	*Capricorni*	44.3	−23 51	3	6.85	6.8	9 16 82	6.85	10 2 86	6.8	9 29 88	6.9
3123	128	"	44.8	19 12	4	6.35	6.4	9 16 82	6.35	10 2 86	6.4	9 29 88	6.25
3124	91	*Aquarii*	45.2	+ 0 11	5	6.65	6.7	9 21 84	6.6	10 20 86	6.8	9 18 87	6.55
3125	92	"	45.9	− 3 46	5	6.7	6.7	10 10 82	6.6	10 20 86	6.65	9 18 87	6.75
3126	93	"	46.2	4 35	5	6.95	7.0	10 10 82	6.9	10 20 86	7.0	9 18 87	6.95
3127	129	*Capricorni*	46.3	11 9	3	6.85	7.0	9 16 82	6.8	10 2 86	6.9	9 18 87	6.8
3128	130	"	46.5	14 8	4	5.4	5.4	9 16 82	5.45	10 2 86	5.4	9 29 88	5.4
3129	131	"	46.9	10 54	4	6.45	6.5	9 16 82	6.45	10 2 86	6.6	9 20 87	6.35
3130	94	*Aquarii*	47.7	4 52	5	6.05	6.0	10 10 82	6.1	10 20 86	6.1	9 18 87	6.05
3131	95	"	48.1	3 53	5	6.5	6.4	10 10 82	6.4	10 20 86	6.55	9 18 87	6.5
3132	132	*Capricorni*	49.9	18 29	3	6.6	6.7	9 16 82	6.6	10 2 86	6.55	9 29 88	6.65
3133	133	"	51.0	9 10	5	6.65	6.7	9 16 82	6.7	10 2 86	6.6	9 29 88	6.5
3134	96	*Aquarii*	51.7	6 1	5	6.4	6.5	10 10 82	6.4	10 20 86	6.35	9 18 87	6.4
3135	134	*Capricorni*	51.8	21 47	2	6.5	6.6	10 9 82	6.5	12 25 86	6.5	.. .. ..	...
3136	97	*Aquarii*	52.2	24 26	2	6.9	6.9	10 9 82	6.9	10 19 86	6.9	.. .. ..	...
3137	98	"	52.4	4 58	5	6.45	6.4	10 10 82	6.4	10 20 86	6.55	9 18 87	6.45
3138	21	*Piscis Austrini*	53.7	29 3	3	5.65	5.7	9 14 84	5.7	10 19 86	5.7	9 29 88	5.6
3139	99	*Aquarii*	54.7	0 0	3	6.1	5.9	9 21 84	6.1	10 20 86	6.2	10 15 87	6.05
3140	100	"	55.3	18 30	3	6.55	6.6	9 16 82	6.6	10 2 86	6.55	9 29 88	6.55
3141	101	"	55.6	17 34	3	6.6	6.5	9 16 82	6.6	10 2 86	6.55	9 29 88	6.65
3142	...	*Piscis Austrini*	56.1	39 30	3	7.1	7.2	9 14 84	7.1	10 19 86	7.0	9 29 88	7.2
3143	102	*Aquarii*	56.7	7 8	6	5.85	5.8	10 10 82	5.8	10 20 86	6.0	11 24 86	5.85
3144	103	"	56.9	2 46	5	4.85	4.9	10 9 82	5.1	9 26 84	4.75	10 20 86	4.8
3145	23	*Piscis Austrini*	57.2	30 31	3	6.9	7.0	9 14 84	6.9	10 19 86	6.95	9 29 88	6.9
3146	24	" "	57.4	26 29	3	6.95	6.9	9 14 84	7.0	10 19 86	6.95	9 29 88	6.95
3147	25	" "	57.5	27 26	3	6.15	6.1	9 14 84	6.2	10 19 86	6.1	9 29 88	6.1
3148	104	*Aquarii*	58.4	1 31	4	5.6	5.7	9 21 84	5.7	10 20 86	5.5	9 18 87	5.5
3149	105	"	59.4	0 56	10	2.7	2.7	9 21 84	2.1	9 26 84	2.8	10 2 86	2.7
3150	106	"	59.4	15 30	5	7.0	7.0	10 9 82	7.1	10 19 86	7.0	9 18 87	7.0
3151	107	"	21 59.7	14 29	7	4.15	4.4	10 9 82	4.6	10 19 86	4.1	11 24 86	4.15
3152	108	"	22 0.3	22 51	3	6.95	7.0	10 9 82	6.9	10 19 86	7.0	9 29 88	6.95
3153	110	"	0.8	15 6	3	6.85	6.9	10 9 82	6.85	10 19 86	6.8	9 29 88	6.9
3154	111	"	2.1	13 55	3	6.95	7.0	10 9 82	7.0	10 19 86	6.95	9 29 88	6.95
3155	112	"	2.1	19 8	7	5.9	5.9	10 10 82	5.75	10 2 86	5.85	9 29 88	5.95
3156	118	"	2.5	24 16	2	6.7	6.6	10 9 82	6.7	10 19 86	6.7	.. .. ..	...
3157	114	"	2.9	8 9	4	6.85	6.9	9 21 84	6.8	10 20 86	6.9	10 15 87	6.95
3158	31	*Piscis Austrini*	2.9	28 54	3	6.7	6.5	9 14 84	6.7	10 19 86	6.75	9 29 88	6.6
3159	115	*Aquarii*	3.8	4 30	3	6.55	6.5	9 21 84	6.5	10 20 86	6.65	10 15 87	6.5
3160	116	"	3.9	11 26	4	6.9	6.8	10 9 82	7.0	10 19 86	7.0	9 29 88	6.85
3161	117	"	3.9	12 11	3	5.65	5.6	10 9 82	5.7	10 19 86	5.6	9 29 88	5.6
3162	118	"	4.0	4 53	3	6.45	6.3	9 21 84	6.5	10 20 86	6.4	10 15 87	6.45
3163	119	"	4.1	21 51	2	6.3	6.4	10 9 82	6.3	10 19 86	6.3	.. .. ..	...
3164	120	"	5.7	14 49	6	6.25	6.4	10 9 82	6.2	10 19 86	6.5	11 24 86	6.2
3165	33	*Piscis Austrini*	5.9	26 57	4	6.4	6.4	9 14 84	6.5	10 19 86	6.4	11 26 86	6.3
3166	121	*Aquarii*	6.2	5 20	4	6.7	6.7	9 21 84	6.6	10 20 86	6.65	11 26 86	6.75
3167	34	*Piscis Austrini*	6.7	25 48	4	6.0	5.9	9 14 84	6.0	10 19 86	6.0	11 26 86	6.1
3168	122	*Aquarii*	6.8	12 33	2	7.0	7.0	10 9 82	7.0	10 19 86	7.0	.. .. ..	...
3169	35	*Piscis Austrini*	7.2	28 23	5	5.5	5.6	9 14 84	5.4	10 19 86	5.4	11 26 86	5.45
3170	123	*Aquarii*	22 7.4	21 42	4	5.85	5.8	10 9 82	5.9	10 19 86	5.8	11 18 86	5.8

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
3171	124	*Aquarii*	22 7.8	−24 37	3	7.0	6.9	10 9 82	7.05	10 19 86	6.9	10 15 87	7.0
3172	125	"	7.9	16 26	4	6.7	6.8	10 9 82	6.6	10 19 86	6.8	10 15 87	6.65
3173	36	*Piscis Austrini*	9.6	26 31	4	6.55	6.5	9 14 84	6.7	10 19 86	6.5	11 26 86	6.55
3174	...	*Aquarii*	9.2	23 38	3	7.4	7.1	10 9 82	7.4	10 19 86	7.5	9 29 88	7.35
3175	126	"	10.0	23 46	3	6.55	6.7	10 9 82	6.5	10 19 86	6.6	9 29 88	6.5
3176	127	"	10.1	13 27	4	5.85	5.8	10 9 82	5.8	10 19 86	5.9	12 17 86	5.8
3177	128	"	10.1	2 13	2	6.4	6.4	9 21 84	6.4	10 20 86	6.4	.. .. ..	...
3178	129	"	10.2	8 24	3	4.35	4.3	10 9 82	4.3	10 19 86	4.4	10 20 86	4.4
3179	130	"	10.3	9 40	4	6.2	6.4	9 21 84	6.2	10 20 86	6.1	10 15 87	6.3
3180	131	"	10.6	6 1	6	6.2	6.4	9 21 84	6.2	10 20 86	6.25	11 24 86	6.15
3181	132	"	11.7	0 52	4	6.7	6.6	9 21 84	6.6	10 20 86	6.8	10 15 87	6.6
3182	133	"	12.3	13 56	4	6.4	6.3	10 9 82	6.4	10 19 86	6.4	12 17 86	6.4
3183	38	*Piscis Austrini*	12.3	28 50	3	6.95	7.0	9 14 84	7.0	10 19 86	6.95	9 29 88	6.95
3184	134	*Aquarii*	13.6	8 27	5	5.45	5.6	10 9 82	5.5	9 21 84	5.6	10 19 86	5.3
3185	135	"	14.7	22 13	5	5.55	5.6	10 9 82	5.5	10 19 86	5.6	11 18 86	5.5
3186	136	"	15.2	2 1	10	3.75	3.9	10 9 82	3.85	9 12 84	4.1	9 26 84	3.8
3187	137	"	16.6	25 24	2	6.0	5.9	10 10 82	6.0	10 19 86	6.0	.. .. ..	...
3188	138	"	17.0	7 50	4	6.35	6.2	9 21 84	6.2	10 20 86	6.4	11 24 86	6.4
3189	139	"	17.6	5 28	5	5.75	5.8	9 21 84	5.7	10 20 86	5.9	11 24 86	5.7
3190	140	"	17.8	14 10	4	6.05	6.1	10 9 82	6.0	10 19 86	6.1	12 17 86	6.1
3191	141	"	18.2	1 49	2	6.9	6.8	9 21 84	6.9	10 20 86	6.9	.. .. ..	...
3192	142	"	18.9	+ 0 45	10	4.7	4.9	10 9 82	4.7	9 12 84	4.9	9 26 84	5.1
3193	143	"	19.0	−20 52	3	6.8	7.0	10 10 82	6.8	10 19 86	6.8	10 3 88	6.85
3194	144	"	19.3	24 19	3	6.4	6.3	10 10 82	6.45	10 19 86	6.3	10 15 87	6.45
3195	145-6	"	19.8	17 23	2	5.9	5.8	10 9 82	5.9	10 19 86	5.9	.. .. ..	...
3196	...	"	19.8	3 25	5	7.0	...	9 21 85	6.9	10 20 86	7.2	11 24 86	6.8
3197	147	"	20.0	8 1	2	6.9	6.9	9 21 84	6.9	10 20 86	6.9	.. .. ..	...
3198	148	"	20.1	11 52	2	6.9	7.0	10 9 82	6.9	10 20 86	6.9	.. .. ..	...
3199	149	"	20.7	1 57	3	6.95	6.9	9 21 84	6.9	10 20 86	7.0	10 3 88	6.95
3200	150-1	"	22.4	0 40	9	3.6	3.5	10 9 82	3.7	9 21 84	3.75	9 26 84	3.4
3201	40	*Piscis Austrini*	22.8	27 45	5	6.2	6.3	9 14 84	6.0	10 15 84	6.2	10 19 86	6.3
3202	152	*Aquarii*	23.3	13 33	3	6.55	6.5	10 9 82	6.6	10 19 86	6.5	9 29 88	6.5
3203	153	"	23.6	15 13	3	6.35	6.3	10 9 82	6.4	10 19 86	6.3	9 29 88	6.3
3204	154	"	24.0	11 19	4	4.85	5.1	10 9 82	5.0	10 19 86	4.85	10 15 87	4.75
3205	41	*Piscis Austrini*	24.0	26 43	3	6.7	6.7	9 14 84	6.7	10 19 86	6.7	9 29 88	6.65
3206	155	*Aquarii*	24.9	3 33	4	6.55	6.6	9 21 84	6.4	10 20 86	6.6	10 15 87	6.65
3207	157	"	24.8	7 12	4	6.3	6.2	9 21 84	6.5	10 20 86	6.4	9 30 88	6.2
3208	156	"	25.1	11 33	3	6.5	6.7	10 9 82	6.6	10 20 86	6.4	10 15 87	6.5
3209	158	"	26.0	7 7	4	7.05	7.0	9 21 84	7.0	11 24 86	7.2	12 20 86	7.1
3210	159	"	27.5	10 15	4	6.8	6.7	9 21 84	6.9	10 20 86	6.85	9 30 88	6.8
3211	160	"	27.6	2 13	3	6.15	6.2	9 21 84	6.2	10 20 86	6.15	10 3 88	6.15
3212	161	"	27.9	21 21	5	5.55	5.7	10 10 82	5.65	10 19 86	5.45	11 18 86	5.6
3213	162	"	28.7	24 38	3	6.25	6.2	10 10 82	6.3	10 19 86	6.2	10 3 88	6.3
3214	163	"	28.9	0 46	9	3.95	4.1	10 9 82	4.1	9 12 84	3.9	9 26 84	4.1
3215	164	"	29.1	18 6	3	6.65	6.7	10 10 82	6.6	10 19 86	6.75	10 15 87	6.6
3216	165	"	29.4	17 2	3	6.7	6.7	10 10 82	6.7	10 19 86	6.75	10 3 88	6.6
3217	166	"	31.3	4 52	5	5.2	5.2	9 21 84	4.9	10 20 86	5.25	11 24 86	5.3
3218	167	"	31.8	8 33	5	6.45	6.4	9 21 84	6.4	10 20 86	6.6	11 24 86	6.4
3219	48	*Piscis Austrini*	31.8	29 24	4	6.7	6.8	9 21 84	6.6	10 19 86	6.7	10 15 87	6.75
3220	168	*Aquarii*	32.7	10 41	4	6.85	6.9	9 21 84	6.9	10 20 86	6.85	9 30 88	6.8
3221	50	*Piscis Austrini*	32.8	28 59	4	6.45	6.5	9 21 84	6.3	10 19 86	6.5	10 15 87	6.45
3222	169	*Aquarii*	33.5	10 1	4	6.85	6.8	9 21 84	6.9	9 26 84	6.9	10 20 86	6.85
3223	52	*Piscis Austrini*	22 33.7	27 42	3	4.05	4.3	9 21 84	4.0	10 19 86	4.15	10 15 87	4.05

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m	° ′									
3224	170	*Aquarii*	22 34.2	−24 10	3	6.9	6.9	10 10 82	6.9	9 21 84	6.8	10 19 86	7.0
3225	171	"	34.3	4 12	6	6.65	6.4	9 21 84	6.9	10 20 86	6.6	11 24 86	6.7
3226	53	*Piscis Austrini*	35.4	30 1	3	6.55	6.5	9 21 84	6.6	10 19 86	6.6	9 29 88	6.5
3227	172	*Aquarii*	35.6	5 45	3	6.85	6.7	9 21 84	6.9	10 20 86	6.8	10 3 88	6.9
3228	...	"	36.3	0 35	3	7.0	7.3	9 21 84	7.0	10 20 86	7.0	10 3 88	7.0
3229	173	"	36.4	0 25	2	7.0	7.0	9 21 84	7.0	10 20 86	7.0	.. .. ..	...
3230	174	"	36.5	8 58	6	6.4	6.6	9 21 84	6.3	10 20 86	6.6	11 24 86	6.4
3231	175	"	36.7	7 37	5	6.4	6.4	9 21 84	6.3	10 20 86	6.5	11 24 86	6.4
3232	176	"	36.9	19 29	5	5.0	4.9	10 9 82	5.0	10 19 86	5.15	11 18 86	5.05
3233	54	*Piscis Austrini*	38.7	25 54	3	6.5	6.5	9 21 84	6.6	10 19 86	6.45	10 15 87	6.5
3234	177	*Aquarii*	39.7	11 49	2	6.9	7.0	9 21 84	6.9	10 20 86	6.9	.. .. ..	...
3235	178	"	40.7	18 13	4	6.8	6.9	10 10 82	6.7	10 19 86	6.75	10 3 88	6.95
3236	179	"	40.9	20 16	5	5.5	5.4	10 9 82	5.3	10 19 86	5.45	11 18 86	5.6
3237	180	"	41.1	14 43	4	5.8	5.8	10 9 82	5.95	10 20 86	5.7	11 24 86	5.75
3238	57	*Piscis Austrini*	41.1	26 34	4	6.4	6.5	9 21 84	6.3	10 19 86	6.45	10 15 87	6.5
3239	...	*Aquarii*	41.4	4 53	4	6.65	6.7	9 21 84	6.8	10 20 86	6.6	10 15 87	6.55
3240	58	*Piscis Austrini*	41.6	28 13	3	6.8	6.8	9 21 84	6.8	10 19 86	6.8	9 29 88	6.85
3241	181	*Aquarii*	41.9	11 13	4	6.35	6.2	9 21 84	6.4	9 26 84	6.3	10 20 86	6.4
3242	182	"	42.5	23 45	4	7.0	7.0	10 10 82	7.0	10 19 86	7.0	11 26 86	6.9
3243	183	"	43.0	14 15	9	4.45	4.2	10 9 82	4.0	10 2 86	4.2	10 19 86	4.55
3244	60	*Piscis Austrini*	44.5	30 12	4	6.4	6.4	9 21 84	6.3	10 19 86	6.45	10 15 87	6.4
3245	184	*Aquarii*	45.9	19 42	7	7.1	6.8	10 10 82	7.05	10 19 86	6.9	12 20 86	7.2
3246	185	"	46.1	8 15	10	4.0	3.6	10 9 82	3.7	10 2 86	4.0	10 21 86	3.95
3247	186	"	46.2	10 43	3	6.85	6.8	9 21 84	6.9	10 20 86	6.8	10 13 88	6.9
3248	187	"	46.9	12 17	4	5.9	6.0	9 21 84	5.8	9 26 84	5.9	10 20 86	5.95
3249	188	"	47.0	6 39	4	6.9	6.9	9 21 84	7.0	10 20 86	6.8	10 15 87	6.9
3250	189	"	47.4	19 50	3	6.8	7.0	10 10 82	6.8	10 19 86	6.8	9 30 88	6.85
3251	190	"	47.5	12 51	2	7.0	7.0	9 21 84	7.0	10 20 86	7.0	.. .. ..	...
3252	191	"	48.0	16 29	8	3.1	3.2	10 9 82	3.1	10 1 86	3.2	11 18 86	3.0
3253	192	"	48.1	7 52	4	6.65	6.4	9 21 84	6.7	10 20 86	6.65	12 17 86	6.6
3254	193	"	48.2	16 56	3	5.75	5.8	10 10 82	5.8	10 21 86	5.7	10 3 88	5.8
3255	194	"	48.2	23 2	4	6.8	6.8	10 10 82	6.8	10 19 86	6.8	11 26 86	6.8
3256	3	*Piscium*	48.6	+ 0 24	4	6.25	6.3	10 9 84	6.2	10 21 86	6.4	10 15 87	6.2
3257	195	*Aquarii*	48.7	− 5 39	4	5.95	5.9	9 21 84	6.0	10 20 86	5.9	10 15 87	5.95
3258	196	"	48.8	20 48	4	6.75	6.6	10 10 82	6.6	10 19 86	6.8	11 26 86	6.8
3259	4	*Piscium*	50.7	3 55	5	6.45	6.6	10 21 86	6.75	12 21 86	6.35	12 25 86	6.3
3260	197	*Aquarii*	50.8	5 29	4	6.65	6.6	9 21 84	6.7	10 20 86	6.6	10 15 87	6.6
3261	6	*Piscium*	51.8	3 4	3	6.4	6.2	10 9 84	6.4	10 21 86	6.4	9 29 88	6.4
3262	7	"	52.0	2 5	4	6.4	6.5	10 9 84	6.3	10 21 86	6.4	9 29 88	6.45
3263	68	*Piscis Austrini*	52.8	30 8	3	6.0	5.9	9 21 84	6.0	10 19 86	5.9	9 29 88	6.05
3264	198	*Aquarii*	53.0	13 44	5	6.55	6.6	9 21 84	6.4	9 26 84	6.5	10 20 86	6.65
3265	9	*Piscium*	53.1	+ 0 18	3	5.7	5.4	10 9 84	5.65	10 21 86	5.7	9 29 88	5.7
3266	69	*Piscis Austrini*	53.3	−25 50	3	6.2	6.1	9 26 84	6.1	12 21 86	6.2	9 29 88	6.25
3267	70	" "	53.6	26 18	2	6.6	6.7	9 26 84	6.6	12 21 86	6.6	.. .. ..	...
3268	199	*Aquarii*	53.8	9 33	3	6.9	6.9	9 21 84	6.8	10 20 86	6.95	10 15 87	6.95
3269	10	*Piscium*	54.2	0 29	4	6.55	6.4	10 9 84	6.4	10 21 86	6.6	10 15 87	6.65
3270	71	*Piscis Austrini*	54.5	29 31	4	6.05	5.9	9 21 84	6.0	10 19 86	5.9	10 19 87	6.2
3271	200	*Aquarii*	54.7	23 28	4	6.65	6.7	10 10 82	6.7	10 19 86	6.6	11 26 86	6.65
3272	201	"	54.9	7 44	6	6.5	6.6	9 21 84	6.7	10 20 86	6.35	11 24 86	6.5
3273	202	"	55.1	5 23	4	6.15	6.1	9 21 84	6.3	10 20 86	6.1	10 15 87	6.1
3274	203	"	56.0	19 13	6	6.75	7.0	10 10 82	6.7	10 21 86	7.0	11 24 86	6.7
3275	204	"	56.1	7 15	6	6.55	6.4	9 21 84	6.7	10 20 86	6.45	11 24 86	6.45
3276	205	"	22 56.1	21 32	4	6.55	6.5	10 10 82	6.55	10 19 86	6.45	11 26 86	6.6

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag
			h. m.	° ′									
3277	73	*Piscis Austrini*	22 56.9	−27 29	2	7.0	6.9	9 26 84	7.0	12 20 86	7.0	.. .. ..	...
3278	74	" "	56.9	31 7	4	6.95	7.0	9 26 84	6.9	10 19 86	6.95	9 29 88	7.0
3279	206	*Aquarii*	57.5	5 28	4	6.75	6.9	9 21 84	6.7	10 20 86	6.8	10 15 87	6.8
3280	75	*Piscis Austrini*	58.1	27 49	4	7.0	7.0	9 26 84	6.9	12 21 86	7.0	9 29 88	7.1
3281	207	*Aquarii*	58.6	17 45	3	6.35	6.3	10 10 82	6.3	10 21 86	6.4	9 30 88	6.3
3282	208	"	58.7	8 22	4	5.4	5.4	9 21 84	5.5	10 20 86	5.4	11 21 86	5.3
3283	209	"	58.7	17 34	5	7.2	6.9	10 10 82	7.2	10 21 86	7.3	11 24 86	7.2
3284	...	"	58.8	8 26	6	7.1	7.4	9 21 84	6.8	10 20 86	7.4	11 24 86	7.8
3285	16	*Piscium*	58.9	+ 0 38	4	6.6	6.6	10 9 84	6.5	10 20 86	6.75	12 21 86	6.6
3286	...	*Aquarii*	22 59.3	8 36	4	6.85	...	9 21 84	6.8	10 20 86	6.95	10 25 88	6.8
3287	210	"	23 0.0	−24 25	11	4.5	4.4	10 9 82	4.65	9 21 84	4.5	9 26 84	4.5
3288	1	*Sculptoris*	0.2	30 43	3	6.75	6.7	9 26 84	6.8	10 19 86	6.75	10 31 88	6.75
3289	2	"	1.6	29 30	4	5.85	6.0	9 26 84	5.9	12 20 86	5.85	10 19 87	5.75
3290	...	*Piscis Austrini*	2.2	26 30	3	6.9	...	12 21 86	7.0	12 25 86	6.85	9 29 88	6.85
3291	17	*Piscium*	2.3	+ 1 27	4	5.3	5.6	10 9 84	5.3	10 21 86	5.25	12 21 86	5.4
3292	211	*Aquarii*	2.8	−21 51	10	3.7	3.7	10 9 82	3.65	9 21 84	3.8	9 26 84	3.7
3293	3	*Sculptoris*	3.0	28 46	3	6.3	6.3	9 26 84	6.3	10 19 87	6.3	10 31 88	6.35
3294	212	*Aquarii*	3.2	23 8	11	4.8	4.9	10 9 82	4.9	9 21 84	4.7	9 26 84	4.9
3295	213	"	3.3	15 11	4	6.65	6.8	10 13 84	6.5	10 21 86	6.7	11 24 86	6.7
3296	4	*Sculptoris*	4.0	30 12	4	6.6	6.6	9 26 84	6.7	10 19 86	6.55	10 19 87	6.5
3297	214	*Aquarii*	4.2	6 38	3	6.95	6.9	10 9 84	6.95	10 20 86	6.9	10 31 88	7.0
3298	215	"	7.9	6 43	7	4.35	4.1	10 9 82	4.1	10 2 86	4.3	11 26 86	4.4
3299	216	"	8.2	11 22	4	6.7	6.5	10 13 84	6.6	10 21 86	6.75	12 20 86	6.7
3300	5	*Sculptoris*	9.0	30 32	4	6.75	6.7	9 26 84	6.7	10 19 86	6.75	10 19 87	6.75
3301	217	*Aquarii*	9.1	4 11	2	5.5	5.4	10 9 84	5.5	10 20 86	5.5	.. .. ..	...
3302	218	"	9.3	9 46	6	4.2	4.1	10 9 82	4.1	10 2 86	4.3	11 21 86	4.3
3303	20	*Piscium*	9.3	+ 0 38	3	6.9	6.8	10 9 84	7.0	10 21 86	6.8	10 19 87	6.9
3304	219	*Aquarii*	10.4	− 8 25	5	5.35	5.3	10 9 84	5.3	10 20 86	5.3	11 21 86	5.65
3305	6	*Sculptoris*	10.4	29 7	4	6.6	6.5	9 26 84	6.7	12 20 86	6.6	10 19 87	6.5
3306	220	*Aquarii*	10.5	7 51	3	6.75	6.8	10 9 84	6.7	10 20 86	6.8	10 31 88	6.7
3307	...	"	10.9	16 51	4	6.9	...	10 13 84	6.5	10 21 86	7.0	12 20 86	7.0
3308	221	"	11.1	12 24	7	6.45	6.6	10 13 84	6.35	10 21 86	6.7	11 24 86	6.3
3309	222	"	11.4	9 52	7	4.1	4.2	10 9 82	4.35	10 2 86	4.05	11 21 86	4.0
3310	8	*Sculptoris*	12.2	31 14	3	6.9	6.9	9 26 84	6.8	10 19 86	6.95	10 19 87	6.95
3311	9	"	12.4	29 4	4	6.7	6.8	9 26 84	6.7	12 20 86	6.6	10 19 87	6.75
3312	223	*Aquarii*	12.5	10 18	8	4.6	4.8	10 9 82	4.65	10 2 86	4.4	11 21 86	4.7
3313	224	"	12.5	11 8	4	5.45	5.5	10 13 84	5.55	10 21 86	5.45	10 22 86	5.45
3314	225	"	12.8	18 46	3	6.7	6.8	10 10 82	6.75	10 21 86	6.7	10 31 88	6.7
3315	226	"	12.9	5 48	3	5.55	5.6	10 9 84	5.6	10 20 86	5.5	10 31 88	5.6
3316	227	"	13.8	4 36	4	6.65	6.5	10 9 84	6.6	10 20 86	6.6	10 3 88	6.7
3317	228	"	14.2	6 35	4	6.3	6.4	10 9 84	6.2	10 20 86	6.4	10 19 87	6.2
3318	11	*Sculptoris*	14.6	27 40	4	5.9	6.0	9 26 84	5.7	10 20 86	6.0	12 21 86	5.9
3319	229	*Aquarii*	14.9	5 21	4	6.6	6.7	10 9 84	6.5	10 20 86	6.6	10 31 88	6.7
3320	230	"	16.1	15 44	3	5.3	5.3	10 13 84	5.3	10 21 86	5.3	10 22 86	5.3
3321	231	"	16.4	20 47	9	4.0	3.9	10 9 82	3.9	9 21 84	4.1	9 26 84	4.0
3322	24	*Piscium*	17.1	0 24	4	6.6	6.4	10 9 84	6.7	10 21 86	6.5	12 19 86	6.5
3323	232	*Aquarii*	17.3	9 9	4	6.9	6.9	10 9 84	7.1	10 21 86	6.9	10 19 87	6.8
3324	233	"	17.5	22 27	3	6.85	6.8	10 10 82	6.9	10 22 86	6.8	10 31 88	6.9
3325	234	"	17.5	19 23	3	6.7	6.9	10 10 82	6.75	10 21 86	6.7	10 31 88	6.7
3326	235	"	19.5	21 20	12	4.55	4.4	10 9 82	4.4	9 21 84	4.5	9 26 84	4.3
3327	12	*Sculptoris*	19.6	28 6	4	6.7	6.6	10 20 86	6.6	10 20 86	6.7	12 21 86	6.75
3328	236	*Aquarii*	21.6	12 8	3	6.95	7.0	10 10 82	7.0	10 22 86	6.9	10 31 88	7.0
3329	237	"	23 21.6	12 8	3	6.75	6.7	10 13 84	6.8	10 21 86	6.7	10 31 88	6.7

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Separate Observations. Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
3330	14	*Sculptoris*	23 21.8	−26 7	4	6.65	6.4	9 26 84	6.7	10 20 86	6.6	10 31 88	6.7
3331	...	*Aquarii*	22.3	6 5	3	7.0	...	10 9 84	7.1	10 21 86	6.9	10 19 87	6.95
3332	238	"	22.6	9 57	4	6.45	6.5	10 13 84	6.6	10 21 86	6.5	11 24 86	6.45
3333	30	*Piscium*	23.0	2 29	5	6.4	6.4	10 9 84	6.3	10 21 86	6.4	10 31 88	6.45
3334	31	"	23.1	1 43	5	6.65	6.8	10 9 82	6.7	10 21 86	6.8	10 10 88	6.55
3335	239	*Aquarii*	23.1	5 13	5	6.25	6.3	10 9 84	6.3	10 21 86	6.25	10 19 87	6.25
3336	240	"	24.6	6 59	4	6.6	6.5	10 9 84	6.5	10 21 86	6.6	10 19 87	6.55
3337	241	"	25.1	4 46	4	6.3	6.3	10 9 84	6.3	10 21 86	6.35	10 19 87	6.3
3338	242	"	25.2	22 4	4	6.4	6.3	10 10 82	6.5	10 22 86	6.3	10 19 87	6.5
3339	...	"	25.3	21 56	3	7.3	7.3	10 10 82	7.2	10 22 86	7.35	10 31 88	7.35
3340	15	*Sculptoris*	25.4	26 26	4	6.55	6.7	9 26 84	6.7	10 20 86	6.5	10 19 87	6.5
3341	32	*Piscium*	25.6	1 47	4	6.5	6.4	10 9 84	6.5	10 21 86	6.5	10 31 88	6.6
3342	243	*Aquarii*	26.0	11 41	4	6.8	6.8	10 13 84	6.8	10 21 86	6.8	10 10 88	6.9
3343	34	*Piscium*	26.5	3 42	4	6.7	6.6	10 9 84	6.7	10 21 86	6.7	10 19 87	6.75
3344	244	*Aquarii*	26.7	21 36	11	4.4	4.5	10 9 82	4.2	9 21 84	4.5	9 26 84	4.5
3345	...	"	26.7	13 18	4	7.0	...	10 13 84	7.0	10 21 86	7.0	11 26 86	6.95
3346	245	"	27.0	5 6	6	6.7	6.8	10 9 84	6.5	10 21 86	6.8	11 24 86	6.65
3347	35	*Piscium*	27.7	1 56	3	5.85	5.9	10 9 84	5.8	10 21 86	5.9	10 31 88	5.85
3348	246	*Aquarii*	28.3	15 56	4	6.5	6.6	10 9 82	6.4	10 21 86	6.6	10 19 87	6.6
3349	247	"	28.8	4 33	4	6.9	6.9	10 9 84	7.0	10 21 86	6.8	10 19 87	6.85
3350	248	"	29.1	8 9	3	6.6	6.5	10 13 84	6.6	10 21 86	6.55	10 31 88	6.6
3351	19	*Sculptoris*	29.1	28 11	3	6.55	6.5	9 26 84	6.6	10 20 86	6.5	10 31 88	6.5
3352	249	*Aquarii*	29.6	9 27	3	7.0	7.0	10 13 84	7.0	10 21 86	7.0	10 31 88	7.0
3353	20	*Sculptoris*	29.6	27 34	5	6.45	6.4	9 26 84	6.6	10 20 86	6.5	10 31 88	6.4
3354	250	*Aquarii*	31.2	13 45	3	6.0	6.0	10 13 84	6.05	10 21 86	6.0	10 31 88	6.0
3355	251	"	31.6	15 47	3	6.8	7.0	10 9 82	6.8	10 21 86	6.8	10 31 88	6.85
3356	252	"	31.8	9 19	3	6.95	6.9	10 13 84	7.0	10 21 86	7.0	10 31 88	6.9
3357	253	"	33.3	14 55	3	5.1	5.2	10 21 86	5.1	10 22 86	5.15	10 25 88	5.0
3358	254	"	34.4	8 36	4	6.95	7.0	10 13 84	6.8	10 21 86	7.0	10 19 87	7.05
3359	255	"	34.7	12 22	3	6.15	6.2	10 13 84	6.2	10 21 86	6.2	10 31 88	6.0
3360	256	"	35.1	18 43	4	5.85	5.8	10 9 82	5.9	10 20 86	5.75	10 19 87	5.7
3361	257	"	35.3	18 31	4	5.0	5.0	10 9 82	5.1	10 20 86	4.9	10 19 87	5.0
3362	258	"	36.0	16 8	4	5.8	5.7	10 9 82	5.9	10 21 86	5.8	10 22 86	5.8
3363	259	"	36.2	15 14	8	4.6	4.7	10 9 82	4.5	10 21 86	4.8	10 22 86	4.8
3364	261	"	37.7	18 58	4	5.4	5.2	10 9 82	5.4	10 20 86	5.5	10 19 87	5.35
3365	26	*Sculptoris*	38.0	26 56	3	6.3	6.3	9 26 84	6.3	10 20 86	6.3	11 3 88	6.3
3366	262-3	*Aquarii*	39.5	19 22	4	5.35	5.4	10 9 82	5.4	10 20 86	5.2	10 19 87	5.4
3367	264	"	40.8	12 36	4	5.75	5.9	10 13 84	5.7	10 21 86	5.65	10 22 86	5.7
3368	43	*Piscium*	41.5	3 27	7	5.6	5.5	10 9 84	5.45	10 13 84	5.7	10 21 86	5.6
3369	265	*Aquarii*	42.1	7 5	6	6.5	6.4	10 13 84	6.8	10 17 84	6.5	10 21 86	6.45
3370	27	*Sculptoris*	42.4	28 49	4	4.6	4.6	9 26 84	4.5	10 21 86	4.6	11 3 88	4.7
3371	28	"	42.9	28 33	4	6.7	6.8	9 26 84	6.6	10 21 86	6.75	10 19 87	6.8
3372	266	*Aquarii*	43.1	16 33	4	6.8	6.8	10 9 82	6.8	10 13 84	6.8	10 17 84	6.7
3373	46	*Piscium*	43.1	+ 0 23	3	5.65	5.8	10 18 84	5.7	10 22 86	5.65	11 3 88	5.6
3374	29	*Sculptoris*	43.4	−26 2	3	6.4	6.5	9 26 84	6.4	10 21 86	6.4	11 3 88	6.4
3375	267	*Aquarii*	43.7	11 48	4	6.85	6.9	10 13 84	6.8	10 17 84	6.9	10 21 86	6.85
3376	268	"	43.8	10 40	5	6.15	5.8	10 13 84	6.2	10 21 86	6.2	10 22 86	6.05
3377	269	"	44.1	15 6	5	6.0	6.0	10 13 84	5.8	10 21 86	6.05	11 24 86	6.1
3378	...	"	44.0	15 17	3	7.05	7.1	10 13 84	7.1	10 21 86	7.0	11 3 88	7.0
3379	1	*Ceti*	50.1	25 26	4	6.5	6.3	9 26 84	6.5	10 21 86	6.55	10 31 88	6.55
3380	270	*Aquarii*	44.9	19 36	4	5.1	5.1	10 9 82	5.1	10 19 84	5.15	10 20 86	5.0
3381	271	"	46.1	14 57	4	6.2	6.2	10 13 84	6.2	10 17 84	6.1	10 21 86	6.2
3382	272	"	23 46.2	19 15	5	7.15	7.0	10 9 82	7.3	10 21 86	7.0	11 24 86	7.2

No.	U. A. No.	Name.	1875. R. A.	1875. Decl.	No. Obs.	Mag. Mean Obs'd.	Mag. U. A.	Date.	Mag.	Date.	Mag.	Date.	Mag.
			h. m.	° ′									
3383	32	*Sculptoris*	23 46.2	−25 41	4	6.7	6.7	9 26 84	6.6	10 21 86	6.75	10 19 87	6.8
3384	273	*Aquarii*	46.4	9 42	5	5.6	5.6	10 13 84	5.4	10 21 86	5.5	10 22 86	5.6
3385	50	*Piscium*	46.5	3 51	4	6.15	6.1	10 9 84	6.1	10 13 84	6.2	10 21 86	6.1
3386	274	*Aquarii*	46.9	24 55	4	6.25	6.3	9 26 84	6.3	10 21 86	6.1	10 19 87	6.25
3387	33	*Sculptoris*	47.9	27 44	3	6.4	6.4	9 26 84	6.4	10 21 86	6.4	11 3 88	6.4
3388	52	*Piscium*	48.4	0 35	4	6.1	5.9	10 18 84	6.1	10 22 86	6.1	10 10 88	6.2
3389	275	*Aquarii*	48.6	10 9	4	6.8	6.8	10 13 84	6.8	10 17 84	6.9	10 21 86	6.7
3390	276	"	49.4	13 51	4	6.9	7.0	10 13 84	6.8	10 17 84	6.9	10 21 86	7.0
3391	36	*Sculptoris*	50.7	27 19	5	6.65	6.4	9 26 84	6.5	10 21 86	6.55	11 3 88	6.65
3392	2	*Ceti*	50.8	21 32	5	6.9	7.0	11 9 84	6.8	10 22 86	6.95	10 23 86	7.0
3393	3	"	51.9	16 33	6	6.6	6.8	12 29 82	6.5	10 21 86	6.75	11 19 86	6.6
3394	55	*Piscium*	52.3	4 15	4	5.0	5.1	10 13 84	5.2	10 21 86	5.0	10 19 87	4.95
3395	38	*Sculptoris*	53.0	30 11	3	6.05	5.8	9 26 84	6.0	10 21 86	6.0	11 3 88	6.1
3396	57	*Piscium*	53.3	6 35	4	6.7	6.9	10 13 84	6.6	10 21 86	6.75	10 19 87	6.8
3397	...	"	53.4	0 59	4	7.15	7.1	10 18 84	7.2	10 22 86	7.15	11 3 88	7.05
3398	39	*Sculptoris*	55.0	29 25	4	7.0	6.9	9 26 84	6.9	10 21 86	7.0	11 3 88	7.1
3399	58	*Piscium*	55.4	3 43	4	4.95	5.0	11 13 84	5.0	10 21 86	4.8	10 19 87	5.0
3400	59	"	55.6	6 43	4	4.5	4.4	10 13 84	4.5	10 21 86	4.4	10 19 87	4.6
3401	...	*Ceti*	55.8	14 7	3	7.0	...	10 13 84	7.0	10 21 86	7.0	10 19 87	6.95
3402	42	*Sculptoris*	55.9	30 25	3	5.0	5.2	9 26 84	4.9	10 21 86	5.1	10 19 87	5.0
3403	60	*Piscium*	56.0	+ 8 16	2	6.5	6.4	1 9 82	6.5	11 27 86	6.5	.. .. ..	...
3404	61	"	56.1	7 48	2	5.6	5.7	1 9 82	5.6	11 27 86	5.6	.. .. ..	...
3405	4	*Ceti*	56.5	−20 45	6	6.45	6.8	11 9 84	6.6	10 22 86	6.5	10 23 86	6.4
3406	5	"	56.7	24 51	3	6.8	6.7	11 9 84	6.8	10 22 86	6.7	11 3 88	6.85
3407	6	"	57.3	18 2	10	4.4	4.3	12 29 82	4.5	11 9 84	4.25	11 11 84	4.4
3408	...	*Sculptoris*	57.5	29 5	2	6.9	6.9	9 26 84	6.9	10 21 86	6.9	.. .. ..	...
3409	44	"	57.8	30 50	3	6.85	6.9	9 26 84	6.8	10 21 86	6.9	11 3 88	6.8
3410	7	*Ceti*	57.9	17 13	3	5.95	5.9	12 29 82	6.0	10 21 86	5.9	11 3 88	6.0
3411	45	*Sculptoris*	57.9	29 58	4	6.45	6.3	9 26 84	6.5	10 21 86	6.4	11 3 88	6.35
3412	...	"	58.0	30 5	3	7.4	7.4	10 21 86	7.35	12 25 86	7.25	11 3 88	7.5
3413	8	*Ceti*	58.1	11 12	4	5.2	5.3	12 29 82	5.15	10 23 86	5.2	11 3 88	5.25
3414	62	*Piscium*	58.7	1 12	3	6.55	6.5	10 18 84	6.5	10 22 86	6.6	11 3 88	6.5
3415	63	"	23 58.9	6 24	5	4.65	4.8	10 13 84	4.4	10 21 86	4.6	12 21 86	4.65

NOTES.

10 *Ceti.* 12.20.86, 6.1; 12.25.86, 6.1; 10.19.87, 6.1.
65 *Piscium.* 10.22.86, 6.4.
66 " 10.22.86, 6.5.
12 *Ceti.* 11.7.88, 6.25.
13 " 11.7.88, 6.5.
51 *Sculptoris.* 12.2.88, 5.4.
67 *Piscium.* 11.7.88, 6.05.
14 *Ceti.* 12.4.88, 5.85.
.. *Piscium.* 12.21.86, 6.9. Gould, Gen. Cat., No. 87.
15 *Ceti.* 11.26.86, 4.75; 11.9.87, 4.8; 11.7.88, 4.8.
17 " 11.7.88, 6.95.
56 *Sculptoris.* 12.2.88, 6.35.
68 *Piscium.* 10.22.86, 7.3; 12.21.86, 7.3; 10.19.87, 7.3; 11.7.88, 7.3; 12.23.88, 7.3; 1.19.89, 7.3. This star has not been found brighter than 7.1.
21 *Ceti.* 11.7.88, 6.95.
22 " 11.3.88, 5.6.
23 " 11.18.86, 7.15; 11.28.86, 7.0; 12.20.86, 7.0; 10.19.87, 7.05; 11.7.88, 6.85; 12.4.88, 6.9. The estimates vary from 6.85 to 7.3.
25 *Ceti.* 11.18.86, 4.7; 11.26.86, 4.7; 12.25.86, 4.85; 10.19.87, 4.95; 11.9.87, 4.6. The estimates of this red star vary from 4.1 to 4.95, yet are fairly accordant if we exclude the first observation made in 1882.
27 *Ceti.* 11.3.88, 5.6; 12.23.88, 5.6. The observations exhibit a slight progressive brightening.
.. *Ceti.* 12.21.86, 6.9.
70 *Piscium.* 12.6.88, 5.9.
72 " 12.6.88, 6.85.
74 " 10.19.87, 6.9; 11.7.88, 7.1.
28 *Ceti.* 11.18.86, 6.7.
75 *Piscium.* 12.6.88, 6.85.
29 *Ceti.* 11.18.86, 6.7.
.. *Piscium.* 10.22.86, 7.1; 12.22.88, 7.1.
30 *Ceti.* 11.7.88, 6.7.
.. *Piscium.* 10.22.86, 7.1.
33 *Ceti.* 11.28.86, 3.75; 12.20.86, 3.65. The estimates of this star give values for the magnitude ranging from 3.3 to 3.75, yet its brightness may explain the discordant results.
78 *Piscium.* 10.22.86, 6.9.
80 " 11.17.87, 7.5; 12.6.88, 7.4. Although the first observation of this red star, in 1882, agrees with the estimates of Gould, 7.0, subsequent numerous estimates have invariably found the star very faint 7.4 or 7.5 mag. This would imply variation?
81 *Piscium.* 12.6.88, 5.6. The estimates of this red star are discordant, ranging from 5.3 to 5.7.
82 *Piscium.* 10.22.86, 6.9.
62 *Sculptoris.* 12.2.88, 5.2.
36 *Ceti.* Variability established by Chandler in 1882 and confirmed by my observations. Max. 5.0. Min. 7.0. Period irregular. The character of the variation resembles that of *R Scuti.*
83 *Piscium.* There appears to be no star in the place of 83 *Piscium* brighter than 8^m, although the star was apparently observed in a sequence, on January 9, 1882, as 6.8. In the same R.A. occurs a star which was observed, inserted on the map, and designated 83 b *Piscium.* This star probably refers to 83, but the declination is $-5° 53'$, instead of $+5° 53'$.
84 *Piscium.* 10.22.86, 6.5.
85 " 12.6.88, 5.75.
86 " 12.6.88, 6.95.
87 " 12.5.87, 6.55.
70 *Sculptoris.* 12.2.88, 6.85.
44 *Ceti.* 11.7.88, 6.95.
45 " 11.7.88, 7.0; 12.4.88, 6.9.
50 " 11.7.88, 6.7.
90 *Piscium.* 12.21.86, 5.4; 11.17.87, 5.4; 12.6.88, 5.3.
.. *Ceti.* 10.25.86, 7.0. Not in U. A. DM. $-1°$, 60, 7.5.
77 *Sculptoris.* 12.2.88, 5.85.
52 *Ceti.* 11.12.87, 6.85.
55 " 11.12.87, 5.9; 11.7.88, 5.9.
59 " 2.1.89, 5.9.
60 " 11.7.88, 6.75.
61 " 11.21.86, 6.55; 11.28.86, 6.75; 12.20.86, 6.7; 12.25.86, 6.7; 11.12.87, 6.55; 12.4.88, 6.8. Difficult; no good comparison-stars near; observations vary from 6.55 to 7.1.
.. *Ceti.* 12.23.88, 6.8; 1.19.89, 6.8.
69 " 11.28.86, 7.25; 12.20.86, 7.4; 11.12.87, 7.5. Although this star is given as 7.0 by Gould, it has not been observed brighter than 7.25. The estimates range from 7.25 to 7.5, yet variability is not suspected.
70 *Ceti.* 11.27.86, 2.2.
73 " 12.2.88, 5.25.
75 " 12.20.86, 6.3; 11.7.88, 6.25.
77 " 12.2.88, 5.8.
94 *Piscium.* 2.1.89, 6.0.
79 *Ceti.* 11.17.87, 5.55; 12.2.88, 5.6.
96 *Piscium.* 12.6.88, 5.8.
87 *Sculptoris.* 12.22.88, 6.5.
80 *Ceti.* 12.2.88, 6.2.
81 " 11.7.88, 6.05.
82 " 11.18.86, 6.4; 11.21.86, 6.25; 11.28.86, 6.4; 12.20.86, 6.4.

85 *Ceti.* 12.4.88, 6.95.
98 *Piscium.* 1.13.87, 6.4; 11.17.87, 6.6; 2.6.88, 6.4; 12.6.88, 6.7; 2.1.89, 6.5. Estimates are quite discordant, and range from 6.25 to 6.7. Possibly variable?
88 *Ceti.* 12.2.88, 6.0.
89 " 12.6.88, 5.3.
90 " 12.2.88, 6.55.
97 " Out of position on chart.
99 " 11.7.88, 5.9.
100 " 12.4.88, 7.05.
101 " 11.17,87, 6.7; 12.2.88, 6.7.
97 *Sculptoris.* 12.4.88, 6.3.
103 *Ceti.* 12.4.88, 5.8.
104 " 12.20.86, 6.2; 11.17.87, 6.3.
107 *Piscium.* 11.17.87, 6.9; 12.4.88, 6.8; 2.1.89, 6.85.
110 *Ceti.* 11.28.86, 6.6; 12.20.86, 6.5; 12.25.86, 6.6; 12.4.88, 6.5. Six observations in 1886 and 1888 are fairly accordant, ranging only from 6.5 to 6.7; yet the star was estimated as bright as 6.2 on January 7, 1882. Gould, 6.3.
108 *Piscium.* 12.4.88, 6.9.
109 ". 12.21.86, 5.55; 12.6.88, 5.65. Estimates range from 5.4 to 5.8.
111 *Ceti.* 11.19.86, 3.25; 11.21.86, 3.35; 11.26.86, 3.4; 11.27.86, 3.3. Always observed brighter than Gould.
110 *Piscium.* 12.4.88, 7.0.
112 *Ceti.* 11.28.86, 6.4; 11.12.87, 6.8; 12.22.88, 6.75; 2.1.89, 6.6. Observations are discordant, and range from 6.4 to 6.8.
113 *Ceti.* 11.28.86, 6.25; 12.4.88, 6.2.
111 *Piscium.* 12.4.88, 7.0. The four estimates show a slight progressive brightening from 7.2 to 7.0.
112 *Piscium.* 12.4.88, 6.6.
115 *Ceti.* 11.28.86, 6.55; 12.4.88, 6.6. Estimates vary from 6.4 to 6.7.
114 *Piscium.* 12.6.88, 6.1.
120 *Ceti.* 11.17.87, 6.65; 12.4.88, 6.5.
128 " 12.2.88, 6.25.
130 " 10.23.86, 6.7; 11.18.86, 6.9; 11.28.86, 6.9; 12.22.88, 6.8.
131 *Ceti.* 11.17.87, 6.65; 12.4.88, 6.5.
109 *Sculptoris.* 12.28.88, 6.2.
136 *Ceti.* 11.19.86, 3.5; 11.21.86, 3.5; 11.26.86, 3.5; 11.27.86, 3.4.
137 *Ceti.* 11.18.86, 5.75; 12.22.88, 6.0.
140 " 10.23.86, 6.5; 11.18.86, 6.5; 11.28.86, 6.6; 12.22.88, 6.5. Estimates in 1882–84 range from 6.4 to 6.8; but appear accordant in 1886–88.
116 *Piscium.* 12.24.88, 6.85.
142 *Ceti.* Numerous observations (33 in number), from 1882 to 1888, give very accordantly 6.65. Gould, variable 6.5 to 8.0. See A. J., No. 184.
143 *Ceti.* 12.2.88, 6.8.

117 *Piscium.* 11.17.87, 6.5; 12.24.88, 6.5.
145 *Ceti.* 11.26.86, 5.4; 12.22.88, 5.45.
112 *Sculptoris.* 12.28.88, 6.9.
147 *Ceti.* 12.23.89, 7.1; 1.21.90, 7.1.
149 " 11.27.86, 6.3; 12.2.88, 6.45.
119 *Piscium.* 12.24.88, 6.6.
... *Ceti.* 12.23.88, 7.0; 1.23.89, 7.0.
157 " 11.28.86, 5.2; 12.24.88, 5.0.
115 *Sculptoris.* 12.24.88, 6.7; 12.28.88, 6.7; 2.1.89, 6.45.
158 *Ceti.* 12.22.88, 6.8.
160 " 12.2.88, 7.5. This star has never been estimated brighter than 7.2. Numerous observations not given in detail invariably make the star 7.4 or 7.5. Marked var.? by Gould in Catalogue, but not in the notes.
118 *Sculptoris.* 12.28.88, 6.0.
165 *Ceti.* 11.26.86, 5.95.
167 " 12.22.88, 5.6; 2.1.89, 5.5.
122 *Piscium.* 12.24.88, 7.0.
169 *Ceti.* 12.22.88, 5.6.
121 *Sculptoris.* 12.28.88, 5.75.
170 *Ceti.* 12.2.88, 6.2.
171 " 12.20.86, 6.65; 11.17.87, 6.65; 12.24.88, 6.65. Two observations in 1884–86 discordant, 6.4 and 6.8; four observations since are very accordant.
172 *Ceti.* 11.28.86, 5.5; 12.24.88, 5.6.
124 *Sculptoris.* 11.9.87, 7.2; 12.28.88, 7.1. Generally seen below 7.0. Gould, 6.9, var.?
173 *Ceti.* 12.24.88, 6.85.
175 " 2.1.89, 5.2.
177 " 11.19.86, 3.15; 11.21.86, 3.25; 11.26.86, 3.2; 11.27.86, 3.2.
178 *Ceti.* 12.24.88, 6.3.
127 *Piscium.* 2.1.89, 4.45.
130 " 12.24.88, 6.85; 2.1.89, 6.75. Estimates discordant, 6.5 to 6.85.
131 *Piscium.* 12.24.88, 6.2.
183 *Ceti.* 12.24.88, 6.9.
185 " 11.19.86, 3.7; 11.21.86, 3.7; 11.26.86, 3.7; 11.27.86, 3.5; 12.22.88, 3.7. Estimates range from 3.5 to 3.9.
133 *Piscium.* 1.29.89, 6.85. Gould, var.?
189 *Ceti.* 1.29.89, 6.0.
190 " 12.28.88, 5.1.
191 " 2.1.89, 6.55.
192 " 11.21.86, 6.4; 11.26.86, 6.35.
134 *Piscium.* 1.29.89, 6.85.
195 *Ceti.* 12.22.88, 6.8.
135 *Piscium.* 12.24.88, 5.95; 1.29.89, 6.15. Gould, var.?
... *Ceti.* 12.24.88, 6.7.
198 " 12.24.88, 5.55.
... " 12.23.89, 7.3.
136 *Piscium.* 1.29.89, 7.05.
137 " 12.25.88, 3.6.
12 *Fornacis.* 12.28.88, 5.55.

199 *Ceti.* 11.21.86, 6.8; 11.26.86, 6.75.
200 " 11.12.87, 7.0.
201 " 11.21.86, 5.45; 11.26.86, 5.45.
202 " 12.24.88, 6.2; 2.1.89, 6.0.
14 *Fornacis.* 12.28.88, 6.45.
203 *Ceti.* 11.21.86, 5.85; 11.26.86, 5.8.
204 " 11.21.86, 6.2; 11.26.86, 6.2; 11.28.86, 5.95.
138 *Piscium.* 1.29.89, 6.5.
139 " 1.29.89, 6.85.
140 " 1.29.89, 6.6; 3.1.89, 6.8.
206 *Ceti.* 2.1.89, 6.6.
207 " 11.21.86, 6.6; 11.26.86, 6.55; 11.28.86, 6.45; 12.25.86, 6.5.
210 *Ceti.* 11.21.86, 6.65; 11.26.86, 6.9; 11.28.86, 6.8.
16 *Fornacis.* 12.28.88, 7.0.
213 *Ceti.* 11.27.86, 6.55.
18 *Fornacis.* 12.12.87, 6.45.
215 *Ceti.* 12.13.87, 5.6; 12.25.88, 5.5. This star has apparently brightened from 5.95 in 1882, to 5.5 in 1888; yet this may be due to the difficulty experienced in observing the star, there being no good comparison-stars near.
217 *Ceti.* 1.29.89, 6.7.
218 " 11.26.86, 6.0.
. . . " 12.25.88, 7.4. The observations are very discordant, ranging from 7.0 to 7.4. It however lies close to a bright star, and is very difficult to observe.
223 *Ceti.* 12.12.87, 4.7; 12.25.88, 4.6. The observations from 1882 to 1887 show a slight progressive decrease in brightness from 4.4 to 4.7. Gould, 4.3.
224 *Ceti.* 11.21.86, 5.6; 11.26.86, 5.5; 12.25.88, 5.5.
225 " 1.29.89, 6.9.
227 " 12.12.87, 6.7; 12.25.88, 6.65.
228 " 12.12.87, 6.7.
229 " 12.25.88, 6.35.
234 " 11.24.86, 6.55.
22 *Fornacis.* 12.28.88, 6.4.
236 *Ceti.* 11.26.86, 6.0; 12.24.88, 6.1.
237 " 11.26.86, 5.6; 11.28.86, 5.5; 12.25.86, 5.6; 12.24.88, 5.8. Observations discordant, and range from 5.5 to 5.95.
242 *Ceti.* 11.24.86, 7.1; 1.25.89, 7.1; 2.25.89, 7.1. This star has always been observed below 7.0.
244 *Ceti.* 11.24.86, 6.8.
245 " 11.24.86, 6.65; 12.25.86, 6.6; 12.24.88, 6.6.
246 " 12.12.87, 6.85.
249 " 2.13.88, 6.7; 12.25.88, 6.55.
251 " 11.24.86, 4.2; 12.20.86, 4.15; 12.12.87, 4.3; 12.25.88, 4.35.
252 *Ceti.* 12.25.86, 6.8; 12.12.87, 7.1; 2.6.88, 6.75; 2.13.88, 6.85; 12.25.88, 6.9; 1.29.89, 6.8. Estimates very discordant, and range from 6.5 to 7.1. Will bear further watching.
253 *Ceti.* 12.13.87, 7.05; 12.24.88, 7.0.
254 *Ceti.* 12.20.86, 6.3; 12.25.86, 6.25; 12.12.87, 6.4; 12.25.88, 6.35. While the observations of this star are generally accordant, within the limits 6.2 to 6.4, it was once estimated as 6.8.
256 *Ceti.* 11.26.86, 6.4; 12.25.86, 6.1; 12.27.86, 6.3; 12.13.87, 6.35; 12.24.88, 6.45. Estimates discordant, and range from 6.1 to 6.5.
259 *Ceti.* 11.28.86, 5.95; 12.20.86, 6.1; 12.25.86, 5.9; 12.27.86, 6.1; 12.13.87, 5.95; 12.24.88, 5.8; 1.29.89, 5.8. Observations generally accordant, but once estimated as 5.3.
. . . *Ceti.* 1.16.88, 6.9. Not in U.A. DM. +0°, 415, 7.5.
260 " 11.26.86, 5.75; 12.24.88, 5.8.
. . . " Discovered by me to be variable in 1885, period 233 d. Attains the magnitude 6.8 at maximum, and is No. 893 in Dr. Chandler's Catalogue.
34 *Fornacis.* 12.12.87, 5.0; 12.28.88, 4.9. Difficult, no good comparison-stars near.
264 *Ceti.* 12.13.87, 6.35; 1.29.89, 6.3.
265 " 11.26.86, 5.8; 11.28.86, 5.8; 12.20.86, 5.8; 12.25.86, 5.7. Generally observed between the limits 5.6 to 5.8, but once estimated as 6.1.
267 *Ceti.* 11.24.86, 7.0; 11.26.86, 6.9.
270 " 11.28.86, 5.05; 12.24.88, 5.1; 12.25.88, 5.3. Estimates range from 4.9 to 5.3.
. . . *Ceti.* 1.16.88, 7.05. SDM. 15°, 458, 7.0.
271 " 11.26.86, 5.45; 12.12.87, 5.6; 12.24.88, 5.55. Estimates range from 5.45 to 5.8.
272 *Ceti.* 12.20.86, 6.1; 12.25.86, 6.15; 12.13.87, 6.15; 1.29.89, 6.1. While Gould has the magnitude of this star as 5.6, it has never been observed brighter than 6.05 at Cambridge. The extreme range is from 6.05 to 6.3, while the mean of seven observations is 6.1. Differences of half a magnitude between Gould's estimates and mine are rare. Variable?
274 *Ceti.* 12.24.88, 6.95.
276 " 1.29.89, 6.3.
277 " 11.24.86, 6.15; 11.26.86, 6.0; 12.25.86, 6.3; 12.24.88, 5.95. Estimates range from 5.7 to 6.3. Variable?
280 *Ceti.* 2.1.89, 7.0.
281 " 12.24.88, 6.95.
282 " 12.27.86, 6.8; 12.12.87, 6.75; 12.24.88, 6.65; 1.29.89, 6.6. Estimates range from 6.6 to 7.0.
283 *Ceti.* 12.25.88, 3.9.
284 " 11.28.86, 4.6; 12.27.86, 4.85.
285 " 12.25.86, 6.35; 1.29.89, 6.25.
286 " 11.26.86, 5.5; 11.28.86, 5.5; 12.27.86, 5.65; 12.12.87, 5.5; 12.24.88, 5.5; 12.25.88, 5.5. Estimates range from 5.35 to 5.7.
288 *Ceti.* 11.26.86, 6.3; 12.24.88, 6.1. While four estimates range only from 6.1 to 6.3, the star was estimated as bright as 5.9 on February 15, 1882.
289 *Ceti.* 11.24.86, 6.45; 11.26.86, 6.5.

290 *Ceti.* 1.29.89, 6.2.
291–2 " 12.25.88, 3.15.
293 " 11.24.86, 6.9; 11.26.86, 6.9; 12.24.88, 6.85.
295 " 11.28.86, 4.45; 12.25.88, 4.45. Once estimated as faint as 4.7.
296 *Ceti.* 11.21.86, 3.95; 11.26.86, 3.95; 12.24.88, 4.0.
297 " 12.25.86, 6.0; 12.27.86, 6.3; 12.25.88, 6.0. Estimates discordant, and range from 6.0 to 6.5.
298 *Ceti.* 12.25.88, 7.0.
299 " 11.16.88, 7.05; 12.25.88, 6.9. Estimates range from 6.85 to 7.2.
28 *Eridani.* 11.16.88, 7.2; 12.25.88, 7.2; 1.25 90, 7.1; 2.25.90, 7.1. Always seen fainter than 7.0.
50 *Fornacis.* 12.28.88, 6.3. Estimates range from 6.3 to 6.6.
33 *Eridani.* 11.26.86, 6.5; 12.28.88, 6.4
301 *Ceti.* 1.16.88, 6.9; 12.25.88, 6.9.
37 *Eridani.* 12.21.86, 6.8; 12.28.88, 6.95. Estimates range from 6.6 to 6.95.
302 *Ceti.* 1.16.88, 6.85; 12.25.88, 6.7.
303 " 12.25.88, 7.0.
304 " 1.16.88, 6.65; 12.25.88, 6.7.
39 *Eridani.* 2.22.86, 4.0; 2.23.86, 3.9; 11.18.86, 3.65; 11.26.86, 4.05; 11.27.86, 3.7; 12.28.88, 4.1. Estimates range from 3.65 to 4.1.
40 *Eridani.* 12.28.88, 5.1.
306 *Ceti.* 12.25.88, 6.7.
307 " 12.25.88, 6.7.
41 *Eridani.* 11.19.86, 5.7; 12.28.88, 5.6.
61 *Fornacis.* 1.18.87, 6.35.
45 *Eridani.* 12.28.88, 6.3.
308 *Ceti.* 12.25.88, 4.75.
46 *Eridani.* 12.21.86, 5.5; 1.16.88, 5.5; 12.28.88, 5.6. Generally observed as 5.5 or 5.6; but once estimated as faint as 5.9.
47 *Eridani.* 12.28.88, 6.95.
63 *Fornacis.* 1.18.87, 6.3.
51 *Eridani.* 12.21.86, 6.85; 12.25.86, 6.95; 12.12.87, 6.9; 12.28.88, 6.95. Six observations give values ranging only from 6.8 to 6.95; but once estimated as bright as 6.45.
52 *Eridani.* 11.26.86, 6.1; 12.21.86, 6.2; 12.28.88, 5.95. Observations somewhat discordant, and range from 5.95 to 6.3.
310 *Ceti.* 12.25.88, 2.6.
311 " 3.1.89, 6.15. This star shows a progressive brightening from 6.5 to 6.15, and should be further observed.
53 *Eridani.* 12.12.87, 6.0; 12.28.88, 6.1.
68 *Fornacis.* 1.16.87, 6.05; 1.18.87, 6.0; 12.28.88, 6.15.
55 *Eridani.* 11.26.86, 5.7; 12.28.88, 5.7.
56 " 11.26.86, 3.9; 12.25.88, 4.1.
... *Ceti.* 12.25.88, 7.2.
57 *Eridani.* 11.26.86, 5.2; 12.21.86, 5.4; 12.25.86, 5.4; 12.12.87, 5.35; 12.28.88, 5.4. Observations discordant, and range from 5.1 to 5.6.
59 *Eridani.* 12.28.88, 6.95.
62 " 12.28.88, 6.95.
314 *Ceti.* 3.1.89, 6.7.
69 *Fornacis.* 1.16.87, 6.05; 1.18.87, 6.1; 12.28.88, 6.1.
67 *Eridani.* 1.16.87, 6.5.
74 *Fornacis.* 1.18.87, 6.45.
76 " 1.18.87, 6.45.
78 " 1.18.87, 6.3.
73 *Eridani.* 2.24.86, 4.6; 11.26.86, 4.6; 12.21.86, 4.4; 1.16.87, 4.7; 12.28.88, 4.8. Estimates range from 4.4 to 5.1.
74 *Eridani.* 1.18.87, 6.3; 12.28.88, 6.0; 3.1.89, 6.35. Estimates range from 6.0 to 6.55. Should be further watched.
76 *Eridani.* 2.3.88, 7.3; 12.28.88, 6.95; 3.1.89, 7.25; 3.23.89, 7.3. Observations discordant, and range from 6.95 to 7.3. Var.?
318 *Ceti.* 12.27.86, 5.6; 12.28.88, 5.6. Four observations accordantly 5.6, but once observed as 5.9.
319 *Ceti.* 12.28.88, 5.1; 3.1.89, 5.0. Difficult, no good comparison-stars near.
82 *Fornacis.* 1.18.87, 6.0; 12.28.88, 6.1.
79 *Eridani.* 2.24.86, 5.2; 11.26.86, 5.15.
320 *Ceti.* 2.3.88, 7.15; 2.6.88, 7.15; 12.28.88, 6.9. Estimates range from 6.85 to 7.15.
81 *Eridani.* 11.18.86, 3.8; 11.19.86, 3.6; 11.26.86, 3.95; 1.18.87, 4.15; 1.27.87, 3.85; 2.3.88, 3.9; 12.25.88, 3.8. Our numerous observations range from 3.6 to 4.15, the average being 3.8, or nearly half a magnitude fainter than the U. A. estimates. Variable?
321 *Ceti.* 12.20.86, 6.2; 12.28.88, 6.1.
85 *Fornacis.* 1.18.87, 6.9.
86 " 1.18.87, 6.6; 12.28.88, 6.6.
84 *Eridani.* 3.1.89, 6.7.
87 *Fornacis.* 1.18.87, 6.4.
86 *Eridani.* 12.21.86, 6.35; 1.16.87, 6.7; 1.18.87, 6.5; 12.25.88, 6.3. Estimates quite discordant, and range from 6.3 to 6.8. A difficult star to observe, the comparison-stars not being well situated.
87 *Eridani.* 1.16.87, 6.85.
88 " 3.1.89, 6.85.
90 *Fornacis.* 1.18.87, 6.1.
91 *Eridani.* 12.25.88, 6.15.
93 " 12.25.86, 6.15; 1.18.87, 6.4; 1.27.87, 6.5; 2.12.87, 6.5; 2.3.88, 6.3; 12.25.88, 6.25. Estimates range from 6.15 to 6.5, and exhibit a progressive increase and decrease in brightness. Variable?
94 *Eridani.* 3.1.89, 5.65.
98 " 1.27.87, 7.0; 12.25.88, 6.95.
97 " 2.24.86, 4.8.
7 *Tauri.* 2.3.88, 6.65; 12.25.88, 6.5.
8 " 1.29.89, 6.0.
94 *Fornacis.* 12.28.88, 6.25.

101 *Eridani.* 2.33.86, 3.5; 11.26.86, 3.6.

102 " 2.3.88, 6.9; 12.25.88, 7.0. This star appears to be slightly out of position, both in the Catalogue and on the chart.

... *Eridani.* 2.3.88, 6.95; 1.3.90, 7.0; 1.29.90, 7.0. Not in Gould's U. A. SDM. 7°, 624 and 625, 7.7 and 8.2.

103 *Eridani.* 11.18.86, 3.9; 11.19.86, 4.0; 11.26.86, 3.95; 1.18.87, 4.05; 2.3.88, 4.05; 12.25.88, 4.05. Our nine estimates of this star make it more than half a magnitude brighter than the Cordoba estimates.

104 *Eridani.* 12.25.88, 6.5.

97 *Fornacis.* 12.28.88, 6.5.

105 *Eridani.* 1.18.87, 6.9; 12.25.88, 6.75.

106 " 12.25.88, 5.9.

10 *Tauri.* 2.3.88, 6.65; 12.25.88, 6.5. Estimates range from 6.3 to 6.65.

11 *Tauri.* 11.27.86, 4.4.

107 *Eridani.* 2.24.86, 5.2.

... *Tauri.* 12.28.88, 7.5. Estimates range from 7.15 to 7.55.

109 *Eridani.* 12.25.86, 6.1; 1.18.87, 6.15; 2.3.88, 6.1; 12.25.88, 6.15. Observations generally very accordant 6.1 or 6.15; but observed once each in 1885 as 5.8 and 6.45.

12 *Tauri.* Always seen fainter than 7.0.

111 *Eridani.* 3.1.89, 6.35.

112 " 1.18.87, 6.7; 2.3.88, 6.55; 12.28.88, 6.7. Estimates range from 6.55 to 6.9.

... *Eridani.* 2.3.88, 6.95; 1.3.90, 7.0; 1.23.90, 6.9. Not in U. A. SDM. 7°, 654, 7.0.

15 *Tauri.* 2.6.88, 7.0.

... *Eridani.* 1.3.90, 7.1; 1.23.90, 7.0. Not in U. A. SDM. 17°, 707, 6.8.

114 *Eridani.* 12.25.88, 6.55.

... " 2.3.88, 6.95. Not in U. A. Gould's Gen. Cat. 4029, 7¼; SDM. 3°, 592, 7.2.

115 *Eridani.* 1.18.87, 5.65; 2.3.88, 5.65; 12.25.89, 5.8. Estimates range from 5.6 to 6.0.

117 *Eridani.* 3.1.89, 6.55.

119 " 12.25.88, 6.5.

120 " 12.25.88, 6.8.

102 *Fornacis.* 12.28.88, 6.9; 3.1.89, 6.9. A progressive fading from 6.6 to 6.9 apparently shown.

121 *Eridani.* 2.23.86, 3.3; 11.26.86, 3.2.

122 " 3.1.89, 5.95.

123 " 11.27.86, 5.5; 12.25.86, 5.4.

125 " 2.13.87, 6.15; 12.25.88, 6.1.

16 *Tauri.* 2.6.88, 6.8; 1.29.89, 6.9. Generally observed as 6.8 or 6.9; but once estimated as bright as 6.5.

127 *Eridani.* 2.24.86, 4.9; 11.26.86, 4.9; 1.16.87, 5.0; 2.3.88, 5.0. Usually observed as 4.9 or 5.0; but once estimated as 4.5.

128 *Eridani.* 2.24.86, 4.25; 11.18.86, 4.1; 11.19.86, 4.2; 11.26.86, 4.1; 12.25.88, 4.05. Generally observed fainter than 4.0; but once estimated as bright as 3.6.

129 *Eridani.* 2.13.87, 6.35; 12.25.88, 6.3.

130 " 2.24.86, 5.5; 11.19.86, 5.3; 11.26.86, 5.45. Estimates range from 5.1 to 5.6.

107 *Fornacis.* 12.28.88, 7.1. Always seen below 7.0.

131 *Eridani.* 1.18.87, 6.8; 2.6.88, 6.85; 12.25.88, 6.85. Five observations give very accordantly 6.8 or 6.85; but once estimated as 6.4.

132 *Eridani.* 3.1.89, 6.35.

134 " 1.18.87, 6.65; 1.27.87, 6.6; 2.6.88, 6.6; 12.25.88, 6.75. Estimates range from 6.4 to 6.75; but always seen brighter than at Cordoba.

139 *Eridani.* 1.27.87, 6.75; 2.6.88, 6.9; 12.25.88, 6.9. Never seen brighter than 6.6. At Cordoba 6.2.

140 *Eridani.* 12.25.86, 6.65; 2.6.88, 6.8; 12.25.88, 7.0. Estimates range from 6.6 to 7.0. The discordant results obtained in the observations of the group embracing the stars 131, 134, 139, and 140 *Eridani*, may possibly be explained if we infer one or more of these stars to vary. Further observations are desirable.

144 *Eridani.* 12.25.88, 5.7.

145 " 1.18.87, 6.7; 12.25.88, 6.65. Estimates range from 6.4 to 6.7.

148 *Eridani.* 11.27.86, 4.8.

149 " 2.24.86, 4.65; 11.18.86, 4.3; 11.19.86, 4.5; 11.26.86, 4.7; 12.25.88, 4.3. Observations discordant, and range from 4.3 to 4.7.

150 *Eridani.* 12.25.88, 6.75.

152 " 1.27.87, 6.25; 12.25.88, 6.2.

154 " 2.12.87, 6.55; 12.25.88, 6.5.

155 " 12.25.88, 6.35.

158 " 2.23.86, 2.8; 11.26.86, 2.7.

159 " 12.25.88, 6.25.

160 " 2.3.88, 6.1; 12.25.88, 6.05.

161 " 2.24.86, 4.4; 11.18.86, 4.4; 11.19.86, 4.6; 11.26.86, 4.4; 12.25.88, 4.3. Estimates range from 4.1 to 4.6.

162 *Eridani.* 11.27.86, 5.2.

164 " 11.27.86, 5.7.

166–7 " 12.25.88, 6.0; 3.1.89, 6.0.

172 " 12.25.88, 6.5.

174 " 2.6.88, 5.85.

176 " 12.25.88, 6.85.

177 " 2.6.88, 6.95; 12.25.88, 6.95.

178 " 12.25.88, 6.95.

179 " 1.18.87, 7.05; 2.6.88, 7.0; 1.29.89, 7.0.

181 " 2.6.88, 5.45.

182 " 3.1.89, 7.15; 3.23.89, 7.2; 1.23.90, 7.2. This star has apparently faded from 6.95 to 7.2.

183 *Eridani.* 12.27.86, 5.9; 2.6.88, 5.85.

184 " 2.6.88, 6.1.

185 " 1.27.87, 4.0; 2.6.88, 4.0. Estimates range from 4.0 to 4.4.

187 *Eridani.* 2.6.88, 5.8.

189 " 12.25.88, 6.7.

191 " 1.29.89, 6.7.

192 " 1.29.89, 6.65.

194 " 1.18.87, 5.35; 1.27.87, 5.15; 2.6.88, 5.05; 1.29.89, 5.1. Estimates range from 4.95 to 5.4.

195 *Eridani.* 2.6.88, 7.1; 12.25.88, 6.95.

197 " 1.29.89, 4.55.

199 " 1.29.89, 6.65.

200 " 1.29.89, 6.9.

202 " 1.18.87, 6.45; 2.6.88, 6.5.

203 " 2.6.88, 6.5; 1.29.89, 6.4. This star has apparently diminished in brightness from 6.2 to 6.5.

205 *Eridani.* 2.6.88, 6.25. Generally seen as 6.25 or 6.3; but once estimated as 6.0.

208 *Eridani.* 2.6.88, 6.85; 12.25.88, 6.75.

209 " 2.6.88, 6.6.

210 " 2.6.88, 6.1.

211 " 2.6.88, 6.3; 2.13.88, 6.35.

213 " 1.27.87, 6.5; 2.12.87, 6.6; 2.6.88, 6.7; 1.29.89, 6.65. Estimates vary from 6.5 to 6.85.

214 *Eridani.* 2.25.87, 6.15; 2.6.88, 6.15; 1.29.89, 6.2. Five observations are quite accordant 6.15 and 6.2; but once observed as 5.85.

216 *Eridani.* 2.12.87, 6.35; 2.6.88, 6.25; 1.29.89, 6.4. Five observations range only from 6.25 to 6.4, yet it was estimated as bright as 6.0, March 14, 1882.

221 *Eridani.* 2.12.87, 7.2; 2.6.88, 7.05. Generally observed below 7.0.

222 *Eridani.* 2.25.87, 6.3; 2.6.88, 6.25; 1.29.89, 6.2. Once observed as bright as 5.85; generally 6.2 or 6.3.

225 *Eridani.* 2.6.88, 6.8; 1.29.89, 6.95. Although usually observed as 6.8 or 6.9, it was once estimated as faint as 7.15.

228 *Eridani.* 1.27.87, 5.5; 2.6.88, 5.6.

230 " 2.12.87, 6.9; 2.6.88, 6.8; 1.29.89, 6.85. Estimates range from 6.75 to 7.15.

231 *Eridani.* 2.6.88, 5.5.

235 " 2.1.89, 7.2. The light has apparently faded since 1882, as the estimates progressively diminish from 6.9 to 7.2.

236 *Eridani.* 2.6.88, 6.1; 2.1.89, 6.3. Estimates range from 6.1 to 6.45.

239 *Eridani.* 1.27.87, 5.7; 2.25.87, 5.8; 2.6.88, 5.95. Estimates discordant, and range from 5.6 to 6.0.

240 *Eridani.* 2.25.87, 6.35; 2.6.88, 6.4. Estimates range from 6.2 to 6.55.

241 *Eridani.* 1.27.87, 5.5; 2.6.88, 5.45.

242 " 1.27.87, 5.5.

245 " 2.6.88, 6.4.

246 " 2.6.88, 6.7; 1.29.89, 6.75.

247 " 2.6.88, 6.5.

249 " 2.25.87, 6.85; 2.6.88, 6.9; 1.29.89, 6.85. While five observations give accordantly 6.85 or 6.9, it was estimated once as 7.15.

250 *Eridani.* 2.28.86, 3.9.

... " This star, although not given in the U. A. Catalogue, is inserted on the chart. Probably refers to the pair 5220 and 5221 of the General Catalogue.

253 *Eridani.* 2.6.88, 6.5.

255 " 2.6.88, 5.25.

256 " 2.9.88, 6.5.

257 " 2.9.88, 5.75.

258 " 2.25.87, 5.8; 2.6.88, 5.85; 1 29.89, 5.75.

259 " 2.9.88, 5.05; 2.1.89, 4.5; 3.1.89, 4.9. The estimates of this red star are very discordant, and range from 4.5 to 5.1. The scarcity of good comparison-stars, together with its strong color, renders observations exceedingly difficult.

262 *Eridani.* 2.25.87, 6.2; 2.9.88, 6.3; 2.13.88, 6.25; 2.1.89, 6.2. While six observations in 1887 and 1889 range only from 6.2 to 6.4, the star was estimated as faint as 6.9, March 3, 1882.

263 *Eridani.* 2.25.87, 5.85; 2.9.88, 6.25; 2.13.88, 5.9. Estimates very discordant for this red star, and range from 5.85 to 6.5. Var.?

264 *Eridani.* 2.9.88, 5.4; 2.13.88, 5.45; 2.1.89, 5.5. Estimates range from 5.4 to 5.8.

266 *Eridani.* 2.28.86, 3.9; 2.14.87, 4.05.

1 *Orionis.* 2.6.88, 6.8; 2.2.89, 6.8. Difficult to observe as it lies close to a bright star.

269 *Eridani.* 2.9.88, 5.9; 2.13.88, 5.8; 2.1.89, 5.8. Estimates range from 5.4 to 5.9.

270 *Eridani.* 1.27.87, 6.3; 2.9.88, 6.2.

271 " 2.9.88, 6.0.

16 *Cæli.* 2.6.88, 6.65.

273 *Eridani.* 2.1.89, 7.1.

274 " 2.25.87, 5.4; 2.13.88, 5.3; 2.1.89, 5.35. Estimates range from 4.95 to 5.4. Gould, var.?

275 *Eridani.* 2.13.88, 7.1; 2.1.89, 7.1. Always observed fainter than 7.0. Estimates range from 7.1 to 7.3.

276 *Eridani.* 2.28.86, 4.9; 1.27.87, 4.6; 2.25.87, 4.8; 2.1.89, 4.75. Estimates discordant, and range from 4.3 to 4.9.

278 *Eridani.* 2.25.87, 6.2; 2.9.88, 6.2.

279 " 2.12.87, 6.15; 2.9.88, 6.15.

280 " 2.1.89, 5.95.

1 *Leporis.* 2.24.87, 6.5; 2.6.88, 6.75; 2.1.89, 6.75. Once observed as faint as 7.15.

20 *Orionis.* 2.1.89, 6.6.

3 *Leporis.* 2.19.87, 5.95.

282 *Eridani.* 2.1.89, 6.0.

283 " 1.27.87, 5.25; 2.12.87, 5.25; 2.6.88, 5.35.

25 *Orionis.* 2.1.89, 6.6.

284 *Eridani.* 2.13.88, 6.8; 2.1.89, 6.8.

26 *Orionis.* 3.23.89, 6.9.

285 *Eridani.* 2.13.88, 5.15.

286 " 2.12.87, 7.0.

5 *Leporis.* 2.12.87, 5.3; 2.19.87, 5.1; 2.6.88, 5.2.

6 " 2.12.87, 5.6; 2.19.87, 5.6; 2.24.87, 5.6; 2.6.88,

5.65; 2.1.89, 5.45. This star has apparently faded from 5.1 in 1882 to 5.65 in 1888.

9 *Leporis.* 2.6.88, 6.95.

31 *Orionis.* 1.27.87, 6.5; 2.1.89, 6.45.

11 *Leporis.* 2.1.89, 7.3. Observations apparently show a progressive fading from 7.05 in 1882 to 7.3 in 1889.

12 *Leporis.* 2.24.86, 3.4; 2.28.86, 3.35; 11.26.86, 3.3; 2.2.88, 3.5; 2.13.88, 3.4.

288 *Eridani.* 2.6.88, 5.55.

14 *Leporis.* 2.2.89, 6.2.

289 *Eridani.* 2.13.88, 7.0.

15 *Leporis.* 3.1.89, 6.85; 3.22.89, 6.75.

18 " 2.13.88, 7.15. Always seen fainter than 7.0.

292 *Eridani.* 2.25.87, 5.8; 2.6.88, 5.75. Generally seen as 5.7 or 5.8, but once estimated as bright as 5.45.

293 *Eridani.* 2.24.86, 3.85; 2.28.86, 4.25; 3.7.86, 4.3; 1.27.87, 4.25; 2.12.87, 4.35 · 2.25.87, 4.35; 2.6.88, 4.55. A difficult star to observe; estimates range from 3.85 to 4.8.

... *Leporis.* 2.2.89, 7.25.

42 *Orionis.* 2.1.89, 6.35.

20 *Leporis.* 2.13.88, 6.4; 2.2.89, 6.3. Estimates range from 6.0 to 6.4.

22 *Leporis.* 2.13.88, 6.5.

21 " 2.28.86, 4.5.

23 " 2.24.86, 3.1; 2.28.86, 3.15; 11.26.86, 3.1.

24 " 2.24.86, 4.55; 2.28.86, 4.25; 2.19.87, 4.3.

27 " 1.14.90, 6.9; 2.9.90, 6.9.

28 " 2.12.87, 5.25; 2.19.87, 5.15; 2.13.88, 5.2. Estimates range from 5.1 to 5.55.

33 *Leporis.* 3.1.89, 6.05.

34 " 2.2.89, 6.25.

35 " 2.2.89, 5.9.

36 " 2.24.86, 4.25; 2.28.86, 4.15; 2.19.87, 4.2. The observations are fairly accordant considering the brightness of the star, ranging only from 4.1 to 4.5, but generally 4.2.

37 *Leporis.* 2.28.86, 6.0.

12 *Columbæ.* 2.12.87, 6.0.

38 *Leporis.* 2.19.87, 5.0.

61 *Orionis.* 2.1.89, 5.2.

39 *Leporis.* 2.2.89, 6.9.

40 " 2.2.89, 6.85.

64 *Orionis.* 2.13.88, 6.2.

66 " 2.13.88, 6.95.

43 *Leporis.* 2.28.86, 5.8; 2.19.87, 5.5.

68 *Orionis.* 2.14.87, 4.65.

70 " 3.22.89, 3.4.

46 *Leporis.* 2.2.89, 6.85; 1.14.90, 7.0; 2.9.90, 7.0.

75 *Orionis.* 3.24.89, 6.5.

51 *Leporis.* 2.24.86, 2.95; 2.28.86, 2.9; 11.26.86, 3.05.

79 *Orionis.* 2.13.88, 6.6.

80 " 3.24.89, 6.9.

81 " 2.14.87, 5.7; 2.22.87, 5.7; 2.13.88, 5.7; 2.1.89, 5.75; 3.2.89, 6.0; 3.22.89, 5.65. Observations rather discordant, and range from 5.3 to 6.0. If, however, we exclude the two extreme observations 5.3 and 6.0, made in the years 1882 and 1889 respectively, the other seven estimates are quite accordant ranging only from 5.65 to 5.9. Further observations desirable.

87 *Orionis.* 3.24.89, 6.9.

53 *Leporis.* 2.13.88, 6.0; 2.2.89, 5.95.

90 *Orionis.* 2.22.87, 7.05; 2.13.88, 7.0; 3.4.88, 7.0; 2.1.89, 6.9; 3.23.89, 6.8; 3.24.89, 6.9. This red star has generally been observed as 6.9 or 7.0; but once recorded as 6.65.

91 *Orionis.* 3.24.89, 5.95.

92 " 2.13.88, 6.35; 3.23.89, 6.3; 3.24.89, 6.2.

54 *Leporis.* 2.24.86, 2.65; 2.28.86, 2.65; 11.26.86, 2.9; 2.19.87, 2.8. Estimates of this bright star range from 2.4 to 2.9.

93 *Orionis.* 2.22.87, 6.65; 4.13.87, 6.65; 2.13.88, 6.75; 3.23.89, 6.8; 3.24.89, 6.85. Estimates range from 6.65 to 7.0.

96 *Orionis.* 3.24.89, 6.8.

100 " 2.13.88, 7.05; 3.23.89, 6.95. This red star has apparently brightened from 7.35 in 1882 to 6.95 in 1889. It will bear further watching. Now, 1890, 7.2.

102–3 *Orionis.* No estimations of brightness have been attempted for this excessively difficult pair.

... *Orionis.* 2.13.88, 7.05; 3.23.89, 6.95.

109 " 2.14.87, 5.45; 2,13.88, 5.5.

105 " 2.22.87, 5.7; 2.13.88, 5.55. Always seen fainter than at Cordoba by .3 or .4 of a magnitude.

108 *Orionis.* 3.30.89, 3.1. Very difficult to observe.

111 " 3.2.89, 6.9; 3.22.89, 6.75; 3.23.89, 6.75; 3.24.89, 6.65. Gould, var.? My numerous observations furnish no evidence of change. See A. J., No. 184.

112 *Orionis.* 2.23.89, 1.9.

115 " 2.13.88, 6.6; 3.23.89, 6.6.

117 " 2.22.87, 6.65.

120 " 3.13.87, 6.45; 3.26.87, 6.45; 2.13.88, 6.4. Five observations in 1887 and 1888 give accordantly 6.4 or 6.45; but the star was once estimated as bright as 6.0 in 1882.

122 *Orionis.* 2.13.88, 5.25.

34 *Columbæ.* 2.13.88, 5.55; 2.2.89, 5.45. Estimates rather discordant, and range from 5.4 to 5.8. Comparison-stars not well situated.

123 *Orionis.* 2.13.88, 6.6; 3.24.89, 6.5.

126 " 2.14.87, 1.8.

127 " 2.14.87, 5.45; 2.22.87, 5.6; 3.13.87, 5.5; 2.13.88, 5.6; 3.22.89, 5.75. The observations are fairly accordant if we exclude two made in the years 1882 and 1886 of 6.0 and 5.3 respectively.

129 *Orionis.* 2.13.88, 6.6; 3.23.89, 6.5.

59 *Leporis.* 2.13.88, 6.5.

60 " 2.13.88, 6.7.

134 *Orionis.* 2.22.87, 6.45; 3.13.87, 6.45; 3.26.87, 6.45; 2.13.88, 6.4; 3.23.89, 6.65. Seven observations range only from 6.4 to 6.65; yet it was once estimated as bright as 6.0 in 1882.

61 *Leporis.* 2.2.89, 6.4.

64 " 2.24.86, 3.6; 2.28.86, 3.6; 11.26.86, 3.45; 2.13.88, 3.55. Difficult to observe; estimates range from 3.4 to 3.8.

136 *Orionis.* 3.23.89, 6.8.

66 *Leporis.* 2.24.87, 3,6; 2.13.88, 3.45.

67 " 2.2.89, 6.65.

141 *Orionis.* 2.13.88, 2.2.

... " 3.23.89, 7.3. Estimates for this pair vary from 6.9 to 7.3.

142 *Orionis.* 3.23.89, 6.45.

146 " 2.22.87, 5.85; 2.13.88, 5.9. Four observations fairly accordant 5.8 to 5.95; but once observed in 1882 as faint as 6.2.

71 *Leporis.* 2.24.86, 3.9; 2.28.86, 4.05; 11.26.86, 3.6; 2.19.87, 4.1; 2.22.87, 4.05; 2.13.88, 4.05. The nine estimates are very discordant and range from 3.6 to 4.1.

... *Leporis.* 2.9.90, 7.2.

54 *Columbæ.* 2.2.89, 6.75.

153 *Orionis.* 3.23.89, 7.45.

154 " 2.25.87, 6.0; 3.13.87, 6.05; 3.23.89, 6.05. Estimates range from 5.75 to 6.25.

... *Orionis.* 3.13.87, 6.6; 2.13.88, 6.6; 3.23.89, 6.45. Once observed as faint as 7.0.

76 *Leporis.* 2.24.87, 3.8; 2.13.88, 3.65. Difficult to observe; estimates range from 3.5 to 4.1.

77 *Leporis.* 3.23.89, 7.0.

79 " 2.13.88, 6.65.

157 *Orionis.* 2.22.87, 6.75; 2.13.88, 6.75. Estimates range from 6.4 to 6.8.

80 *Leporis.* 2.2.89, 6.85.

1 *Monocerotis.* Although observed as 7.0 and 6.9 in 1882 and 1887 respectively, it was once estimated as bright as 6.45 in 1889.

160 *Orionis.* 2.13.88, 6.8; 3.23.89, 6.75.

161 " 2.22.87, 5.45; 4.13.87, 5.4; 2.13.88, 5.35; 3.23.89, 5.35. If we exclude the first observation made in 1882 (4.9), the others are fairly accordant, ranging only from 5.35 to 5.55.

83 *Leporis.* 2.13.88, 6.9.

4 *Monocerotis.* 2.13.88, 5.65.

85 *Leporis.* 2.28.86, 5.1; 2.19.87, 5.55; 2.22.87, 5.6; 2.13.88, 5.45; 2.2.89, 5.45; 2.28.89, 5.55; 3.1.89, 5.6. Eight observations made in the years 1882 to 1889 range only from 5.45 to 5.6; yet the star was twice estimated as bright as 5.1 in the years 1882 and 1886. Variable?

86 *Leporis.* 2.19.87, 5.25; 2.13.88, 5.3.

87 " 2.13.88, 7.05; 2.19.88, 7.2; 3.4.88, 7.2; 3.29.88, 7.15; 3.23.89, 7.0. Discovered to be a variable, probably of the *R Scuti* type, in 1891. The mean period appears to be very nearly sixty-nine days, subject however to irregularities. The variation is from about 6.7 to 7.5. See A. J., No. 263.

167 *Orionis.* 2.13.88, 6.95.

91 *Leporis.* 2.25.87, 6.4.

92 " 2.13.88, 6.0.

93 " 2.13.89, 7.1; 1.20.90, 6.8. Generally seen fainter than 7.0.

9 *Monocerotis.* 1.20.90, 7.0.

10 " 2.13.88, 6.9; 1.20.90, 7.0.

96 *Leporis.* 2.13.88, 6.4; 3.23.89, 6.4. A slight progressive fading apparently shown from 6.05 in 1882 to 6.4 in 1888–89.

97 *Leporis.* 3.23.89, 6.0.

98 " 3.23.89, 6.95; 1.20.90, 7.1.

100 " 3.23.89, 6.35. Always seen fainter than at Cordoba, but no signs of variability are apparent.

13 *Monocerotis.* 2.24.87, 6.5.

14 " 2.24.87, 5.8.

103 *Leporis.* 3.4.88, 7.1; 3.23.89, 7.05. Generally seen fainter than 7.0.

2 *Canis Majoris.* 2.13.88, 6.8; 3.3.88, 7.1; 3.24.89, 7.0. Generally observed fainter than 7.0.

3 *Canis Majoris.* 2.13.88, 6.6; 2.29.88, 6.75.

178 *Orionis.* 2.22.87, 6.1; 4.13.87, 6.15; 2.13.88, 6.1; 3.24.89, 6.1; 3.24.84, 6.2. Seven observations range only from 6.1 to 6.3; yet it was estimated once in 1882 as faint as 6.55.

17 *Monocerotis.* 2.19.87, 6.35; 2.24.87, 6.25; 3.20.87, 6.3; 2.13.88, 6.3. Estimates range from 6.1 to 6.6.

18 *Monocerotis.* 3.23.89, 6.5.

4 *Canis Majoris.* 2.29.88, 6.9.

6 " " 2.13.88, 6.35; 3.4.88, 6.5.

9 " " 2.13.88, 6.4.

... " " 2.13.88, 7.15.

12 " " 4.13.87, 7.0; 2.13.88, 6.95.

185 *Orionis.* 2.22.87, 5.95; 3.13.87, 5.9; 2.13.88, 5.85; 3.24.89, 5.85. Six of the seven observations of this red star give values ranging only from 5.85 to 5.95; yet the first estimation, made in 1882, found the star half a magnitude brighter, or 5.3.

21 *Monocerotis.* 2.13.88, 5.7; 3.23.89, 5.85.

... *Canis Majoris.* 3.24.89, 7.25. Generally seen fainter than at Cordoba.

16 *Canis Majoris.* 2.29.88, 7.0; 3.24.89, 7.0. A progressive fading apparently shown from 6.7 in 1882 to 7.0 in 1889.

18 *Canis Majoris.* 3.13.87, 3.2; 2.29.88, 3.25. Estimates vary from 3.0 to 3.4.

17 *Canis Majoris.* 2.24.87, 6.1; 3.24.89, 6.05.

19 " " 2.29.88, 7.0.

22 " " 3.24.89, 6.8.

23 " " 3.13.87, 5.9. Always seen fainter than at Cordoba.

27 *Canis Majoris.* 2.29.88, 7.0; 3.24.89, 7.0.
28 " " 2.13.88, 6.9.
32 *Monocerotis.* 2.13.88, 6.8.
34 " 2.13.88, 6.9.
30 *Canis Majoris.* 2.29.88, 6.75.
35 *Monocerotis.* 2.13.88, 6.9.
40 " 2.13.88, 6.9.
43 " 3.21.87, 6.3; 3.23.87, 6.3.
31 *Canis Majoris.* 2.29.88, 6.85.
45 *Monocerotis.* 3.23.89, 5.55.
... *Canis Majoris.* 2.24.87, 7.3.
48 *Monocerotis.* 3.13.87, 3.9; 2.13.88, 4.1. Estimates vary from 3.9 to 4.4.
50 *Monocerotis.* 3.20.87, 6.6; 2.13.88, 6.8; 3.4.88, 6.75. Estimates vary from 6.45 to 6.8. Always seen fainter than at Cordoba.
44 *Canis Majoris.* 2.27.86, 4.4; 3.13.87, 4.2; 2.25.87, 4.4; 4.13.87, 4.5; 2.29.88, 4.35. Estimates range from 4.2 to 4.7.
46 *Canis Majoris.* 2.29.88, 6.95.
49 " " 2.27.86, 4.8; 3.23 89, 4.8.
51 " " 3.24.89, 6.95.
54 " " 2.27.86, 4.6; 3.5.86, 4.3; 3.25.89, 4.4. The estimates of this red star vary from 4.2 to 4.6.
55 *Canis Majoris.* 3.24.89, 6.8.
57 " " 3.24.84, 4.5; 2.27.86, 5.4; 3.5.86, 5.1; 3.13.87, 5.15; 4.13.87, 5.15; 2.29.88, 4.95; 3.23.89, 5.1. Observations very discordant, and range from 4.5 to 5.4. A red star and difficult to observe.
61 *Canis Majoris.* 3.13.87, 5.65; 3.26.87, 5.6; 4.13.87, 5.55; 2.29.88, 5.75; 3.24.89, 5.5. Estimates discordant, and range from 5.3 to 5.8.
64 *Canis Majoris.* 2.29.88, 7.2; 3.23.89, 7.4; 3.24.89, 7.25; 1.20.90, 7.2; 2.9.90, 7.2. Has apparently faded since 1882 from 7.0 to 7.3.
... *Canis Majoris.* 3.23.89, 7.4; 1.20.90, 7.3; 2.9.90, 7.3.
70 *Monocerotis.* 3.23.89, 6.85; 3.24.89, 7.0. A difficult star to observe.
72 *Monocerotis.* 3.23.89, 7.15; 3.24.89, 7.15. Has apparently decreased from 6.9 in 1882 to 7.15 in 1889.
68 *Canis Majoris.* 2.29.88, 6.75; 4.6.88, 6.85; 3.24.89, 6.6. Estimates somewhat discordant, and range from 6.5 to 6.8.
69 *Canis Majoris.* 3.4.88, 6.8; 3.24.89, 6.75.
71 " " 3.13.87, 5.7; 4.13.87, 5.65; 2.29.88, 5.6; 3.24.89, 5.7; 4.19.89, 5.7. Generally observed as 5.6 or 5.7; but twice estimated in 1886 as bright as 5.3; red.
75 *Monocerotis.* 3.26.87, 5.8; 3.4.88, 5.6; 3.23.89, 5.7; 3.24.89, 5.75. Six observations range only from 5.6 to 5.8; but observed once in 1882 as 6.2. With the exception of the estimation last mentioned, the star has always been seen brighter than at Cordoba.
75 *Canis Majoris.* 3.13.87, 5.4; 4.13.87, 5.4.
77 *Monocerotis.* 3.26.87, 5.9; 3.4.88, 5.7; 3.23.89, 6.0. Has apparently faded from 5.5 in 1882, to 6.0 in 1889.
82 *Monocerotis.* 3.4.88, 6.35.
78 *Canis Majoris.* 4.13.87, 6.6; 3.4.88, 6.75. Estimates discordant, and range from 6.5 to 6.9; difficult; near other stars. Cum.?
83 *Monocerotis.* 3.4.88, 6.4; 3.23.89, 6.65.
... *Canis Majoris.* 3.13.87, 7.1.
79 " " 3.13.87, 6.7; 3.4.88, 6.75; 3.23.89, 6.85. Estimates of this red star vary from 6.35 to 6.85; difficult; no good comparison-stars near.
80 *Canis Majoris.* 3.24.89, 7.1. Always seen fainter than 7.0.
82 *Canis Majoris.* 3.4.88, 6.75; 3.24.89, 6.7.
... " " Combined light of this pair equal 7.0. Separately the estimates are 7.5 and 7.35.
86 *Canis Majoris.* 2.6.88, 7.05.
89 *Monocerotis.* 3.20.87, 6.8; 3.4.88, 6.75.
87 *Canis Majoris.* 3.5.86, 5.0; 3.4.88, 6.75.
88 " " 3.24.89, 6.85.
90 " " 3.4.88, 6.6; 3.24.89, 6.8. Has apparently decreased from 6.4 in 1882 to 6.8 in 1889.
92 *Monocerotis.* 3.4.88, 6.55.
92 *Canis Majoris.* 2.27.86, 4.15; 3.4.88, 4.5; 3.23.89, 4.45. Has apparently faded from 3.75 in 1882, to 4.5 in 1888. Will bear further watching.
95 *Canis Majoris.* 3.5.86, 5.3; 3.26.87, 5.15.
98 " " 2.27.86, 4.7; 3.5.86, 4.6; 3.24.89, 4.7. Estimates vary from 4.6 to 5.0.
94 *Monocerotis.* 3.24.89, 6.7. Difficult; near other stars.
96 " 3.4.88, 7.1. Always seen fainter than 7.0.
100 *Canis Majoris.* 2.9.90, 7.1.
103 " " 3.4.88, 6.65.
105 " " 3.24.89, 5.9.
106 " " 2.27.86, 1.7.
100 *Monocerotis.* 3.4.88, 6.7.
106 " 3.26.87, 6.2; 3.4.88, 6.15; 4.2.88, 6.1; 3.23.89, 6.2. While this star was estimated as 5.7 in 1882, it has not been seen brighter than 6.0 since, and always observed fainter than at Cordoba.
114 *Canis Majoris.* 3.13.87, 4.1; 2.29.88, 4.15. Estimates very discordant, and range from 3.7 to 4.2. This is a very red star, quite bright, and difficult to observe.
108 *Monocerotis.* 3.4.88, 5.5.
115 *Canis Majoris.* 2.27.86, 3.55; 3.4.88, 3.4.
110 *Monocerotis.* 3.4.88, 6.2; 3.23.89, 6.4. Estimates vary from 6.1 to 6.4.
116 *Canis Majoris.* 3.5.86, 4.3; 3.4.88, 4.3.
118 " " 3.4.88, 6.7.
123 " " 2.27.86, 2.2.
114 *Monocerotis.* 3.24.89, 6.6.
124 *Canis Majoris.* 3.24.89, 7.0.
115 *Monocerotis.* 3.6.88, 5.5.
127 *Canis Majoris.* 4.6.88, 6.65.
116 *Monocerotis.* 3.24.89, 6.9.

117 *Monocerotis.* 3.20.87, 6.0. Estimates range from 5.8 to 6.2.

128 *Canis Majoris.* 3.24.89, 6.45.

118 *Monocerotis.* 4.6.88, 4.2; 3.24.89, 4.3. A very difficult star to observe, as it lies close to another, and there are no good comparison-stars near.

129 *Canis Majoris.* 4.6.88, 6.75.

132 *Canis Majoris.* 3.4.88, 6.45.

119 *Monocerotis.* 4.2.88, 6.7; 4.6.88, 6.65; 3.24.89, 6.7. While two observations in 1882 and 1887 give accordantly 6.4, four observations in 1888 and 1889 invariably make the star somewhat fainter, or 6.65 to 6.7.

120 *Monocerotis.* 3.4.88, 6.55.

139 *Canis Majoris.* 3.13.87, 5.3; 3.24.89, 5.45.

140 " " 3.17.87, 4.2; 3.4.88, 4.3; 3.24.89, 4.25. Five observations vary only from 4.1 to 4.3; but once estimated as bright as 3.7.

141 *Canis Majoris.* 3.4.88, 6.75.

122 *Monocerotis.* 3.20.87, 6.5; 3.4.88, 6.55. Estimates range from 6.2 to 6.55.

145–6 *Canis Majoris.* 3.7.86, 5.3; 3.26.87, 5.6; 4.17.87, 5.6; 3.4.88, 5.25; 4.2.88, 5.4; 3.24.89, 5.2. For this double star the estimates of the joint light are quite discordant, ranging from 5.0 to 5.6.

147 *Canis Majoris.* 3.4.88, 5.6; 4.2.88, 5.5; 3.24.89, 5.45. For this red star the estimates range from 5.3 to 5.6.

149 *Canis Majoris.* 3.4.88, 6.95.

150 " " 4.2.88, 5.4; 3.24.89, 5.45. Always seen brighter than at Cordoba.

151 *Canis Majoris.* 3.4.88, 4.55; 3.24.89, 4.6.

152 " " 4.6.88, 6.75.

153 " " 4.6.88, 6.9; 2.11.90, 7.1; 3.9.90, 7.1.

156 " " 3.4.88, 6.3.

158 " " 3.4.88, 6.4; 4.2.88, 6.4; 3.24.89, 6.5.

126 *Monocerotis.* 3.23.89, 6.55.

127 " 3.24.89, 6.45.

160 *Canis Majoris.* 3.4.88, 5.55.

162 " " 4.19.87, 6.1; 3.4.88, 6.15. The estimates of this red star range from 6.0 to 6.3.

167 *Canis Majoris.* 2.22.86, 2.9; 2.27.86, 2.8.

168 " " 4.13.88, 6.75.

169 " " 3.4.88, 6.55; 4.2.88, 6.35. Difficult to observe, as it lies close to other stars; estimates range from 6.35 to 6.6.

170 *Canis Majoris.* 3.4.88, 7.1. Generally seen below 7.0.

130 *Monocerotis.* 3.23.89, 6.4.

172 *Canis Majoris.* 3.24.89, 6.7; 3.30.89, 6.7.

173 " " 4.2.88, 6.4.

175 " " 3.24.89, 7.05.

176 " " 4.2.88, 6.2; 4.6.88, 6.35.

177 " " 4.13.87, 6.1; 3.4.88, 6.1. This star was estimated to be 5.85 and 5.9 in 1882 and 1886, and 6.1 and 6.2 in 1887 and 1888. It has always been seen fainter than at Cordoba.

93 *Puppis.* 3.7.88, 6.05.

136 *Monocerotis.* 3.22.89, 6.45.

97 *Puppis.* 3.4.88, 5.5; 3.24.89, 5.55.

137 *Monocerotis.* 3.7.88, 6.75; 3.23,89, 6.7.

138 " 3.7.88, 7.05; 3.23.89, 6.95. Generally seen fainter than 7.0.

141 *Monocerotis.* 2.11.90, 7.0; 3.9.90, 7.0.

142 " 4.2.88, 6.3; 4.9.88, 6.2.

143 " 3.23.89, 6.75.

105 *Puppis.* 3.24.89, 64; 3.30.89, 6.35.

106 " 3.24.89, 6.55. Always seen brighter than at Cordoba.

107 *Puppis.* 3.7.88, 5.4; 3.28.89, 5.5; 4.19.89, 5.5. Observations discordant, and apparently exhibit a slow progressive fading from 4.8 in 1882 to 5.5 in 1889. Variable?

108 *Puppis.* 3.24.89, 5.2.

109 " 3.7.88, 7.0; 3.24.89, 7.0.

111–2 " 3.4.88, 5.6; 3.24.89, 5.75.

114 " 3.28.89, 7.0.

116 " 3.7.88, 6.8; 4.9.88, 6.7; 3.28.89, 6.5. This star was estimated as bright as 6.2 in 1882; since which it has not been seen brighter than 6.5; and it has been estimated as faint as 6.8. Variable?

144 *Monocerotis.* 3.7.88, 6.8.

122 *Puppis.* 3.30.89, 6.3.

119 " 3.25.87, 5.1; 4.13.87, 5.3; 3.30.89, 5.0. Estimates range from 5.0 to 5.5.

120 *Puppis.* 3.7.88, 7.0; 3.28.89, 7.0.

125 " 3.24.89, 6.15.

126 " 4.2.88, 7.0; 3.24.89, 7.2; 3.30.89, 7.0. Five observations give values ranging only from 7.0 to 7.2; but once estimated in 1882 as 6.65.

128 *Puppis.* 3.25.87, 5.35; 3.30.89, 5.2. Estimates range from 5.2 to 5.5.

132 *Puppis.* 3.24.89, 6.85; 3.30.89, 6.85.

133–4 " 3.25.87, 3.9; 3.30.89, 3.9.

147 *Monocerotis.* 2.12.90, 7.1; 3.17.90, 7.2. Generally seen below 7.0.

135 *Puppis.* 3.30.89, 7.0.

139 " 3.30.89, 7.0; 4.13.87, 7.2.

... " 4.13.87, 7.2; 3.30.89, 7.2. This and the preceding star lie close together and also near the bright double 133–4 *Puppis,* and are very difficult to observe.

140 *Puppis.* 4.24.87, 5.65; 3.29.88, 5.65; 4.9.88, 5.45; 3.30.89, 5.4. The estimates of this red star are quite discordant ranging from 5.1 to 5.7. Variable?

141 *Puppis.* 3.24.89, 6.55; 3.30.89, 6.55.

149 *Monocerotis.* 4.2.88, 4.2.

152 *Puppis.* 3.7.88, 7.0; 3.30,89, 6.95. Estimates range from 6.9 to 7.2.

150 *Monocerotis.* 3.7.88, 6.55; 3.23.89, 6.55.

154 *Puppis.* 3.28.89, 6.5.

155 " 3.25.87, 5.65; 4.19.87, 5.75; 3.7.88, 5.65;

3.29.88, 5.7; 3.30.89, 5.6. The first estimate of this star, made in 1882, agrees with the U. A. magnitude, or 5.0; since which it has not been estimated brighter than 5.55, seven observations ranging only from 5.55 to 5.75.

157 *Puppis.* 3.25.87, 4.3; 3.30.89, 4.35.

151 *Monocerotis.* 2.12.90, 7.0.

152 " 2.12.90, 7.1.

166 *Puppis.* 3.30 89, 6.3. Difficult; lies close to a bright star, and the comparison-stars are not well situated.

153 *Monocerotis.* 3.7.88, 6.2.

... *Puppis.* 3.30.89, 7.3.

... " 3.30.89, 7.6.

170 " 3.30.89, 6.8; 2.13.90, 6.8.

179 " 3.30.89, 6.65. Double, and both components equal; always seen brighter than at Cordoba.

... *Monocerotis.* 2.12.90, 7.0; 3.17.90, 7.0. Not in the U. A. SDM. 6°, 2305, 7.1.

180 *Puppis.* 3.30.89, 5.95.

183 " 3.25.87, 5.0; 3.29.88, 5.0; 4.19.89, 5.25.

186 " 3.30.89, 6.8.

191 " 3.25.87, 3.5.

154 *Monocerotis.* 3.23.89, 6.15.

192 *Puppis.* 4.19.89, 6.95.

155 *Monocerotis.* 3.7.88, 6.7.

203 *Puppis.* 3.30.89, 6.8.

205 " 4.2.88, 5.65; 3.30.89, 5.7.

204 " 4.19.89, 6.35.

206 " 3.30.89, 6.15.

156 *Monocerotis.* 3.7.88, 6.15.

... *Puppis.* 4.19.89, 7.4; 4.28.89, 7.4. Generally seen fainter than at Cordoba; but once estimated as bright as 7.05.

... *Puppis.* 4.19.89, 7.3; 4.28.89, 7.3. The preceding star generally appears the fainter of the two, although the order is reversed in the U. A.

222 *Puppis.* 4.19.89, 4.55. Observations are discordant, and range from 4.55 to 4.95; difficult to observe.

... *Monocerotis.* Always estimated brighter than at Cordoba; but it lies close to a bright star, and hence is difficult to observe.

165 *Monocerotis.* 3.24,89, 6.65.

254 *Puppis.* 4.19.89, 6.95.

256 " 4.6.88, 5.0. Difficult.

261 " 4.6.88, 7.0.

1 *Hydræ.* 3.25.87, 5.85.

... " 4.19.89, 6.65.

5 " 4.2.88, 6.8.

284 *Puppis.* 4.6.88, 6.65; 4.19.89, 6.5; 4.28.89, 6.55. A slight progressive brightening apparently shown from 6.8 to 6.5.

285 *Puppis.* 4.19.89, 64.

7 *Hydræ.* 4.19.89, 6.55.

8 " 4.2.88, 6.6.

9 " 4.19.89, 6.7; 4.28.89, 6.65.

291 *Puppis.* 3.25.87, 6.7; 4.19.87, 6.55; 4.2.88, 6.6. This red star always seen fainter than at Cordoba by half a magnitude.

292 *Puppis.* 4.2.88, 6.0.

293 " 4.6.88, 6.4; 4.19.89, 6.3. Always estimated fainter than at Cordoba by nearly half a magnitude.

13 *Hydræ.* 4.19.89, 6.3.

14 " 3.24.89, 6.4; 4.19.89, 6.7; 4.28.89, 6.65. Observations discordant.

298 *Puppis.* 4.19.89, 6.65.

16 *Hydræ.* 4.2.88, 6.5; 4.19.89, 6.3. Always seen brighter than at Cordoba by nearly half a magnitude.

... *Puppis.* 4.6.88, 7.0. Not in U. A.

... " 4.2.88, 7.1. Not in U. A.

19 *Hydræ.* 4.19.88, 3.8. Difficult; no good comparison-stars near.

301 *Puppis.* 4.3.88, 6.0.

302 " 4.2.88, 5.85; 4.19.89, 6.0. The estimates of this red star are discordant, and range from 5.5 to 6.0. Variable?

303 *Puppis.* 4.19.89, 6.4.

21 *Hydræ.* 3.24.89, 7.0.

308 *Puppis.* 4.2.88, 6.15. The observations at Cordoba on this red star indicate variability; but no confirmatory evidence is furnished by my observations, which range only from 6.0 to 6.2.

24 *Hydræ.* 4.2.88, 6.85.

25 " 4.2.88, 6.6; 4.19.89, 6.55. A slight progressive brightening apparently shown from 6 9 in 1884 to 6.55 in 1889.

27 *Hydræ.* 3.24.89, 6.2.

3 *Pyxidis.* 4.27.87, 6.7; 4.3.88, 6.6. Observations discordant, and range from 6.5 to 6.9.

31 *Hydræ.* 4.2.88, 6.85.

... " 2.16.90, 6.9. Not in U. A. SDM. 15°, 2494, 6.3.

10 *Pyxidis.* 4.3.88, 6.4; 4.6.88, 6.5; 4.19.89, 6.65; 4.28.89, 6.4. Difficult; estimates range from 6.4 to 6.8.

15 *Pyxidis.* 4.3.88, 6.4; 4.19.89, 6.4.

... " 4.19.89, 7.3.

40 *Hydræ.* 3.26.87, 6.75.

41 " 3.26.87, 6.75.

16 *Pyxidis.* 4.19.87, 5.9; 4.24.87, 5.8; 4.3.88, 5.5; 5.7.88, 5.5; 4.19.89, 5.6. Observations somewhat discordant, and range from 5.5 to 5.9; but generally seen as 5.5 or 5.6.

18 *Pyxidis.* 2.21.90, 6.7.

43 *Hydræ.* 3.26.87, 6.9.

19 *Pyxidis.* 4.3.88, 5.35; 4.19.89, 5.4. Always seen brighter than at Cordoba.

44 *Hydræ.* 4.2.87, 5.7; 4.3.88, 5.7. Estimated once each in 1884 and 1885 as 5.5; but three observations in 1887 and 1888 give accordantly 5.7.

45 *Hydræ.* 3.26.87, 6.95; 2.21.90, 6.8.

20 *Pyxidis.* 4.3.88, 5.65. Gould, variable? My four observations, 1884 to 1888, give no indications of variability.

46 *Hydræ.* 5.9.87, 6.9.

51 " 4.3.88, 5.0. Difficult.

25 *Pyxidis.* 4.8.86, 6.6; 4.19.89, 6.55.

56 *Hydræ.* 4.3.88, 6.5; 4.6.88, 6.45; 5.7.88, 6.45. Observed once in 1884 as 6.2; five observations since give invariably 6.4 or 6.5.

60 *Hydræ.* 4.19.89, 4.7. Difficult. Two observations in 1884 and 1887 agree with the Cordoba estimates, 4.4; but the star has been estimated since as 4.65 and 4.7.

61 *Hydræ.* 4.30.89, 5.5. This star has apparently brightened since 1887, for, while in 1884 and 1887 the estimates are 5.8 and 5.85 respectively, it was estimated twice in 1889 as 5.5.

62 *Hydræ.* 4.3.88, 6.75. Estimates range from 6.75 to 7.0.

65 *Hydræ.* 4.28.89, 6.8.

66 " 4.27.87, 6.8; 5.9.87, 6.8; 5.12.87, 6.8. Generally seen as 6.8; but once estimated as 6.5.

32 *Pyxidis.* 4.8.88, 6.8; 4.19.89, 6.75.

36 " 4.3.88, 4.45.

70 *Hydræ.* 5.7.88, 5.95. Gould, variable? My four observations, 1884 to 1888, give no signs of change.

72 *Hydræ.* 4.28.89, 6.95. Estimates vary from 6.8 to 7.1.

74 " 4.19.89, 6.95.

79 " 4.3.88, 6.4.

80 " 4.3.88, 6.0; 4.19.89, 6.05. Estimates range from 6.0 to 6.3.

82 *Hydræ.* 3.26.87, 6.95; 4.3.88, 7.0; 4.19.89, 7.0.

40 *Pyxidis.* 4.3.88, 5.1. Always estimated brighter than at Cordoba.

84 *Hydræ.* 4.19.89, 6.65.

85 " 4.19.89, 6.8.

88 " 4.19.89, 6.3.

... " 3.26.87, 7.15; 4.3.88, 7.0; 4.19.89, 7.0; 2.22.90, 7.2; 3.18.90, 7.2. Always estimated brighter than at Cordoba.

43 *Pyxidis.* 4.19.89, 7.05.

... *Hydræ.* 4.28.89, 7.2. Estimates range from 6.9 to 7.2, and apparently show a slight progressive fading.

92 *Hydræ.* Difficult; no good comparison-stars near, yet observations are quite accordant, 6.0 to 6.1, but give values slightly brighter than at Cordoba.

... *Pyxidis.* 4.3.88, 7.1.

91 *Hydræ.* 5.12.87, 7.15; 4.3.88, 6.95; 4.28.89, 7.2; 2.22.90, 7.25. Estimates for some reason are quite discordant, ranging from 6.8 to 7.2, and suggest variability?

47 *Pyxidis.* 5.7.88, 6.95.

94 *Hydræ.* 4.19.89, 7.0.

99 " 4.3.88, 5.85.

50 *Pyxidis.* 3.7.86, 5.0; 4.17.87, 4.9; 4.24.87, 4.9; 4.3.88, 4.9; 5.7.88, 4.95; 4.28.89, 4.85. Gould, variable? Our numerous estimates (nine) have varied only from 4.8 to 5.0, and furnish no evidence of change in light.

51 *Pyxidis.* Estimates range from 7.0 to 7.3.

52 " 4.19.87, 6.5; 4.3.88, 6.5; 4.28.89, 6.5. Our six observations, 1884 to 1889, are remarkably accordant, always 6.5, which agrees exactly with the Cordoba estimates; a good standard.

102 *Hydræ.* 4.6.88, 6.0; 4.28.89, 6.2. Estimates range from 6.0 to 6.3.

103 *Hydræ.* 4.3.88, 5.85.

109 " 4.13.87, 6.75; 4.20.87, 6.8; 4.3.88, 6.75. Estimates discordant, ranging from 6.6 to 7.0.

111 *Hydræ.* 4.3.88, 6.35.

113 " 4.3.88, 6.95.

114 " Always seen brighter than at Cordoba.

118 " 4.3.88, 6.15.

121 " 4.3.88, 6.0.

126 " 4.3.88, 6.65.

127 " 4.28 89, 6.9.

61 *Pyxidis.* 3.7.86, 5.5; 4.13.87, 5.5. Always seen fainter than at Cordoba; red.

128 *Hydræ.* 4.3.88, 6.95.

62 *Pyxidis.* 3.7.86, 5.15; 4.13.87, 5.3.

133 *Hydræ.* 5.9.87, 7.0; 5.12.87, 7.05; 4.3.88, 6.9. Generally estimated 6.9 to 7.1; but once observed as 6.7.

... *Hydræ.* 3.21.90, 7.0. Not in U. A.

135 " 4.28.89, 6.9.

136 " 4.3.88, 6.55; red.

138 " 4.6.88, 7.05.

66 *Pyxidis.* 4.3.88, 6.55; 4.6.88, 6.5; 5.7.88, 6.5. Gould, variable? Our six observations in 1886 and 1888 give invariably 6.5 or 6.55; no evidence of variability.

141 *Hydræ.* 5.7.88, 5.4.

3 *Leonis.* 4.28.89, 6.3. Difficult; no good comparison-stars near; generally seen as 6.2 or 6.3, but once estimated in 1886 as 5.9.

145 *Hydræ.* 4.6.88, 4.7; 4.8.88, 4.7.

146 " 4.3.88, 6.4. Always seen brighter than at Cordoba.

147 *Hydræ.* 4.3.88, 6.6.

148 " 4.19.87, 6.25; 4.6.88, 6.4.

3 *Antliæ.* 3.7.86, 5.9; 4.13.87, 5.9.

5 " 4.13.87, 7.3; 4.19.87, 7.3; 4.3.88, 7.4; 4.13.88, 7.3; 5.7.88, 7.4; 2.20.90, 7.5; 2.22.90, 7.5; 3.9.90, 7.5; 3.21.90, 7.5. Always seen below 7.0. Variable?

150 *Hydræ.* 4.6.88, 6.1; 4.28.89, 6.3. Estimates range from 6.1 to 6.4.

... *Hydræ.* 4.6.88, 6.95. Not in U. A. Gould, 12953, 8m.

7 *Antliæ.* 4.13.87, 7.0.

152 *Hydræ.* 4.20.87, 4.75; 4.8.88, 4.85.

156 " 4.6.88, 6.15.

12 *Antliæ.* 4.13.87, 6.5.
158 *Hydræ.* 4.28.89, 6.65.
159 " 4.20.87, 6.6; 4.6.88, 6.7.
161 " 4.6.88, 6.95.
163 " 4.6.88, 6.05.
165 " 4.6.88, 6.65.
15 *Antliæ.* 4.13.87, 6.7; 4.6.88, 6.8.
16 " 4.13.87, 6.2; 4.19.87, 6.3; 4.6.88, 6.2. The estimates of this red star are somewhat discordant, ranging from 6.15 to 6.4.
166 *Hydræ.* 3.30.89, 6.85.
170 " 4.20.87, 4.3; 4.8.88, 4.25; 5.7.88, 4.3. Although the first estimate, made in 1884, agrees with the U. A. magnitude (3.9), the star has since been invariably estimated fainter, 4.2 or 4.3.
173 *Hydræ.* 4.6.88, 5.4.
174 " 4.6.88, 5.05.
175 " 4.6.88, 5.2.
23 *Antliæ.* 3.7.86, 5.0; 4.13.87, 5.1.
4 *Sextantis.* 3.30.89, 6.9.
5 " 3.30.89, 6.9.
6 " 4.8.88, 6.95.
30 *Antliæ.* 4.19.87, 6.9; 4.20.87, 6.9; 4.27.87, 6.95; 4.6.88, 7.0; 3.30, 89, 6.95.
177 *Hydræ.* 4.28.89, 7.0.
178 " 4.19.87, 4.1; 4.6.88, 4.4; 3.30.89, 4.3. Estimates range from 3.9 to 4.4.
13 *Sextantis.* 4.8.88, 5.4.
33 *Antliæ.* 4.20.87, 6.65; 4.27.87, 6.65; 4.6.88, 6.7; 3.30.89, 6.6.
34 *Antliæ.* 4.19.87, 6.9; 4.20.87, 6.9; 4.27.87, 6.95; 4.6.88, 7.0; 3.30.89, 6.95. Two observations in 1884 are very discordant, 6.4 and 7.1; six observations since vary only from 6.7 to 7.0; variable? Should receive further attention.
182 *Hydræ.* 4.19.87, 6.5; 4.6.88, 6.55.
184 " 4.6.88, 6.95; 4.28.89, 7.0.
185 " 4.19.87, 6.6; 4.20.87, 6.6; 4.27.87, 6.6; 4.6.88, 6.5; 3.30.89, 6.55.
37 *Antliæ.* 4.13.87, 6.6; 4.19.87, 6.7; 4.20.87, 6.7; 4.27.87, 6.65; 4.6.88, 6.7; 3.30.89, 6.6. Three observations in 1884 and 1885 are perfectly accordant, 6.4, since which the star has always been estimated fainter, 6.6 or 6.7.
20 *Sextantis.* 3.30.89, 6.45; 5.18.89, 6.65.
187 *Hydræ.* 4.19.87. 6.9; 4.27.87, 6.95.
188 " 4.26.86, 6.4; 4.13.87, 6.25; 4.19.87, 6.4; 3.30.89, 6.35.
190 *Hydræ.* 4.28.89, 6.9.
23 *Sextantis.* 5.9.87, 6.75; 4.8.88, 6.45; 4.28.89, 6.65, 3.23.90, 6.8; 4.11.90, 6.8; 4.15.90, 6.8. For this red star the estimates range from 6.4 to 6.8.
191 *Hydræ.* 4.19.87, 6.75; 4.28.89, 6.85.
193 " 4.26.86, 6.1; 4.19.87, 5.9; 4.6.88, 6.0; 4.8.88, 6.0; 3.30.89, 6.0.
194 *Hydræ.* 5.7.88, 4.6; 3.30.89, 4.65. Gould, variable? Our numerous observations, thirty-four in number, give no indications of variability. See note, A. J., No. 184.
195 *Hydræ.* 4.8.88, 6.3; red.
... *Sextantis.* 4.15.90, 7.4.
27 " 4.8.88, 4.55. Always estimated brighter than at Cordoba by nearly half a magnitude.
198 *Hydræ.* 3.30.89, 6.9.
31 *Sextantis.* 4.24.87, 5.95; 5.9.87, 5.95; 4.9.88, 6.15; 4.28.89, 6.1. Estimates range from 5.9 to 6.3.
201 *Hydræ.* 4.22.86, 3.4; red.
202 " 4.30.89, 6.9.
... " 6.2.88, 7.05. Not in U. A. Gould, 13917, 7¼.
206 " 4.20.87, 6.9; 3.30.89, 6.85.
208 " 3.30.89, 6 7.
36 *Sextantis.* 4.28.89, 5.55.
59 *Antliæ.* 3.30.89, 6.0. Estimates vary from 5.6 to 6.0.
209 *Hydræ.* 3.30.89, 6.35.
38 *Sextantis.* 4.9.88, 6.45.
... " 4.9.88, 7.0.
40 " 4.9.88, 7.0.
211 *Hydræ.* 4.8.88, 6.65.
212 " 4.20.87, 6.9; 4.8.88, 6.95.
213 " 4.20.87, 6.5; 4.8.88, 6.6.
214 " 4.20.87, 6.6; 4.8.88, 6.7.
215 " 3.30.89, 7.0.
218 " 4.8.88, 6.9.
42 *Sextantis.* 5.9.87, 6.85.
43 " 4.9.88, 6.2.
219 *Hydræ.* 4.8.88, 6.75.
63 *Antliæ.* 4.8.88, 6.7; 3.30.89, 6.55. Estimates range from 6.3 to 6.7.
47 *Sextantis.* 4.28.89, 6.0.
220 *Hydræ.* 4.8.88, 7.2; 4.28.89, 7.15. Only once seen as bright as at Cordoba, 6.9; four estimates give 7.1 to 7.2.
50 *Sextantis.* 5.9.87, 7.0; 4.9.88, 6.9.
221 *Hydræ.* 4.19.87, 4.1; red.
51 *Sextantis.* 4.28.89, 6.8.
52 " 4.28.89, 6.8.
54 " 4.22.86, 5.6; 4.21.87, 5.45.
224 *Hydræ.* 4.20.87, 6.3; 4.8.88, 6.0; 4.28.89, 6.1. The estimates of this red star vary from 6.0 to 6.3.
68 *Antliæ.* 4.8.88, 5.45; 3.30.89, 5.65. A progressive brightening from 5.9 in 1884 to 5.45 in 1888 is apparently shown from the observations. The star is now, 1889, apparently fading again; further observations desirable.
58 *Sextantis.* 4.28.89, 6.7.
225 *Hydræ.* 5.9.87, 5.9; 5.12.87, 5.9; 4.8.88, 5.9; 4.28.89, 5.9; 4.30.89, 5.9. Six observations invariably give 5.9; yet the star was observed once in 1884 as bright as 5.6, and once in 1887 as 5.5.

227 *Hydræ.* 4.20.87, 6.45 ; 4.8.88, 6.3. Estimates range from 6.3 to 6.6.
60 *Sextantis.* 4.9.88, 6.9.
229 *Hydræ.* 4.9.88, 6.95.
231 " 4.8.88, 6.3. Three observations give 6.3 ; but once estimated as 6.6.
63 *Sextantis.* 4.27.87, 6.75.
235 *Hydræ.* 4.20.87, 6.45 ; 4.8.88, 6.55 ; 5.7.88, 6.7 ; 3.30.89, 6.5. Estimates range from 6.3 to 6.7.
236 *Hydræ.* 4.8.88, 6.25.
238 " 5.7.88, 6.95.
240 " 4.2.88, 5.9 ; 4.9.88, 5.8 ; 5.7.88, 6.05 ; 3.30.89, 6.15. This very red star, marked variable in the U. A. Catalogue, has been under observation as a suspected variable since 1884. The star is very difficult to observe, and no positive evidence of variability was furnished by my observations until 1888. The range of variation appears slight, and the period irregular.
242 *Hydræ.* 4.28.89, 5.2.
243 " 4.8.88, 6.3.
67 *Sextantis.* 4.9.88, 6.9.
245 *Hydræ.* 5.7.88, 6.75.
249 " 4.9.88, 5.6 ; 4.28.89, 5.65.
251 " 4.28.89, 6.6.
71 *Sextantis.* 4.27.87, 7.15 ; 4.9.88, 7.1. Generally seen below 7.0.
253 *Hydræ.* 5.7.88, 6.85.
254 " 4.22.86, 3.1 ; 4.9.88, 3.3. The estimates of this bright red star range from 2.9 to 3.3.
74 *Sextantis.* 5.7.88, 5.85 ; 4.28.89, 6.0.
256 *Hydræ.* Always seen below 7.0.
20 *Leonis.* Difficult ; near another star.
21 " 4.9.88, 6.0.
257 *Hydræ.* 5.7.88, 5.6 ; 4.28.89, 5.65.
1 *Crateris.* 4.24.87, 6.75 ; 4.9.88, 6.8.
2 " 4.24.87, 6.0 ; 4.9.88, 6.0.
3 " 4.9.88, 7.05 ; 4.30.89, 7.05.
4 " 4.24.87, 6.6. Always seen fainter than at Cordoba.
5 *Crateris.* 4.13.88, 4.4 ; red.
6 " 4.24.87, 6.4 ; 4.9.88, 6.25.
7 " 4.24.87, 6.75.
28 *Leonis.* 4.9.88, 5.55.
29 " 4.30.89, 6.95.
261 *Hydræ.* 4.30.89, 6.35.
263 " 4.9.88, 6.85.
9 *Crateris.* 4.9.88, 6.6.
10 " 4.9.88, 6.65.
265 *Hydræ.* 4.9.88, 6.2.
12 *Crateris.* 4.9.88, 6.7 ; 5.6.88, 6.65.
266 *Hydræ.* 5.7.88, 6.8.
267 " 4.13.88, 7.0 ; 5.7.88, 6.9.
268 " 5.7.88, 6.7.
35 *Leonis.* 5.7.88, 6.95.
269 *Hydræ.* 5.7.88, 6.7.
270 " 5.7.88, 6.5.
13 *Crateris.* 4.9.88, 6.85.
272 *Hydræ.* 4.13.88, 6.1 ; 5.7.88, 6.1 ; 4.30.89, 6.1. Gould, variable ? This star has apparently faded from 5.85 in 1884 to 6.1 in 1888 and 1889 ; but the range is too slight to furnish conclusive evidence of change.
273 *Hydræ.* 4.13.88, 7.0 ; 5.7.88, 7.1. Generally seen fainter than 7.0.
274 *Hydræ.* 5.7.88, 6.8.
275 " 4.9.88, 6.7.
16 *Crateris.* 4.9.88, 6.3.
37 *Leonis.* 5.18.89, 5.65.
40 " 5.7.88, 7.0.
19 *Crateris.* 4.9.88, 6.65.
41 *Leonis.* 5.7.88, 7.2. Generally seen fainter than 7.0.
43 " 5.7.88, 4.2 ; 5.18.89, 4.1. Estimates range from 4.05 to 4.4.
23 *Crateris.* 5.7.88, 3.6.
26 " 5.12.87, 5.45 ; 4.13.88, 5.4.
27 " 5.12.87, 5.4.
30 " 5.12.87, 6.8 ; 5.7.88, 6.85.
32 " 5.15.87, 6.0.
59 *Leonis.* 5.7.88, 6.6.
33 *Crateris.* 5.7.88, 6.2. Always seen fainter than at Cordoba.
62 *Leonis.* 5.18.89, 5.1. Difficult ; no good comparison-stars near. Estimates range from 5.0 to 5.3.
... *Crateris.* 5.22.90, 7.0. Not in U. A. SDM. 12°, 3442, 7.2.
287 *Hydræ.* 4.19.88, 5.7.
36 *Crateris.* 5.12.87, 6.3 ; 4.13.88, 6.2.
37 " 4.13.88, 7.1 ; 4.30.89, 7.15. Only once seen brighter than 7.1.
38 *Crateris.* 5.14.87, 4.75 ; 5.7.88, 4.75 ; 4.30.89, 4.7. Five observations range only from 4.7 to 4.9 ; but once estimated as faint as 5.2.
69 *Leonis.* 5.7.88, 4.7 ; 4.30.89, 4.5 ; 5.18.89, 4.5. Very difficult ; no good comparison-stars near. The estimates of this red star range from 4.2 to 4.7.
... *Crateris.* 4.30.89, 7.1.
42 " 4.30.89, 6.2.
43 " 4.30.89, 6.75.
46 " 4.30.89, 6.95.
296 *Hydræ.* 5.7.88, 7.15 ; 4.30.89, 7.05. Double ; estimates of combined light apparently show a progressive fading from 6.8 in 1884 to 7.15 in 1888.
47 *Crateris.* 4.30.89, 6.8.
48 " 5.12.87, 5.15 ; 4.13.88, 5.2.
50 " 4.30.89, 7.0.
298 *Hydræ.* 4.30.89, 5.5. A progressive brightening apparently shown from 5.9 in 1884 to 5.5 in 1889.
51 *Crateris.* 5.7.88, 6.5 ; 4.30.89, 6.4 ; 5.23.89, 6.4. This star has also apparently brightened from 6.7 in 1884 to 6.4 in 1889.

12 *Virginis.* 5.18.89, 6.0.
... *Crateris.* 4.20.90, 6.4. Not in U. A. SDM. 11°, 3190, 6.3.
... *Virginis.* 4.20.90, 7.0. Not in U. A. Gould, 16226, 7.2; SDM. 4°, 3162, 7.0.
52 *Crateris.* 5.7.88, 7.0.
304 *Hydræ.* 5.7.88, 6.55. Estimates range from 6.3 to 6.6.
... " 5.7.88, 6.8; 5.18.89, 7.05. Estimates for this double star range from 6.8 to 7.1.
1 *Corvi.* 5.6.88, 6.7; 4.28.89, 6.65.
2 " 5.7.88, 7.2; 4.28.89, 7.1. Generally seen fainter than 7.0.
306 *Hydræ.* 5.7.88, 6.9.
307 " 5.7.88, 7.1.
309 " 5.7.88, 7.15.
22 *Virginis.* 5.8.89, 7.0.
3 *Corvi.* 4.28.89, 6.3. Difficult; no good comparison-stars near. Estimates range from 6.3 to 6.6.
4 *Corvi.* 4.13.88, 5.4.
28 *Virginis.* 5.23.89, 6.95.
30 " 5.7.88, 6.7.
5 *Corvi.* 5.14.87, 6.9; 5.7.88, 6.7; 5.18.89, 6.9. Estimates somewhat discordant, and range from 6.7 to 7.0.
... *Corvi.* 5.21.90, 7.0. Not in U. A. SDM. 17°, 3562, 7.2.
11 " 5.7.88, 6.75.
13 " 4.27.87, 5.8.
40 *Virginis.* 6.1.88, 6.7; 5.23.89, 6.7. Estimates range from 6.4 to 6.7.
15 *Corvi.* 4.27.87, 6.2. Estimates vary from 6.1 to 6.4.
41 *Virginis.* 5.18.89, 6.3.
17 *Corvi.* 4.22.86, 6.7; 4.27.87, 6.75.
19 " 5.14.87, 6.25; 5.7.88, 6.35.
20 " 4.27.87, 6.85. Estimates range from 6.8 to 7.1.
45 *Virginis.* 5.15.87, 3.9; 5.23.87, 4.0; 6.1.88, 3.6. Estimates range from 3.6 to 4.0.
21 *Corvi.* 5.14.87, 6.45; 5.7.88, 6.4. Generally observed as 6.3 or 6.4; but once estimated as 6.7.
23 *Corvi.* 6.4.86, 5.55; 4.22.86, 5.7.
24 " 5.16.84, 6.8; 5.9.85, 6.8; 4.29.86, 6.9.
25 " 4.29.86, 5.9.
50 *Virginis.* 6.4.86, 6.15; 4.22.86, 6.05; 5.15.87, 6.1.
27 *Corvi.* 5.9.85, 6.7; 4.29.86, 6.6.
30 " 5.6.88, 6.45; 5.7.88, 6.25; 6.2.88, 6.45; 6.3.88, 6.35; 6.4.88, 6.35. Gould, variable? Our eight observations are quite accordant, and furnish no evidence of variability. See note in A. J., No. 184.
32 *Corvi.* 5.7.88, 6.5.
33 " 4.22.86, 5.9; 5.18.89, 5.9. Estimates range from 5.9 to 6.2.
34 *Corvi.* 4.22.86, 6.4; 4.29.86, 6.4; 5.7.88, 6.5. Always seen fainter than at Cordoba.
35 *Corvi.* 4.22.86, 5.9.
36 " Numerous observations of this star in connection with the stars 12, 18, and 28 *Corvi* (all four of which have been suspected to vary, from the Cordoba observations) seem to furnish evidence of change in No. 36 alone. See A. N., No. 2657.
40 *Corvi.* 4.22.86, 6.4; 4.29.86, 6.3; 5.7.88, 6.2.
64 *Virginis.* 5.18.89, 6.9; 5.23.89, 7.0. My five estimates of this star apparently show a slight progressive fading from 6.7 in 1884 to 7.0 in 1889.
41 *Corvi.* 4.22.86, 6.1; 4.29.86, 6.1; 5.7.88, 6.2.
71 *Virginis.* 5.18.89, 6.9; 5.23.89, 6.75. Estimates range from 6.6 to 6.9.
42 *Corvi.* 4.27.87, 6.9.
43–4 " 4.22.86, 5.65; 5.6.88, 5.35; 6.3.88, 5.45; 6.4.88, 5.45. Always seen brighter than at Cordoba.
45 *Corvi.* 4.22.86, 6.3; 4.29.86, 6.2; 5.7.88, 6.1. Estimates range from 6.0 to 6.3.
46 *Corvi.* 4.27.87, 6.9; 5.6.88, 6.85.
47 " 5.6.88, 6.85.
48 " 4.27.87, 6.9.
330 *Hydræ.* 6.3.88, 6.0; red; estimates range from 5.8 to 6.1.
81 *Virginis.* 6.1.88, 6.75; 5.23.89, 6.6. Estimates range from 6.6 to 6.9; double.
49 *Corvi.* Always seen below 7.0.
332 *Hydræ.* 6.3.88, 6.5.
51 *Corvi.* 5.14.87, 6.9; 5.7.88, 7.0.
334 *Hydræ.* 6.1.88, 6.35.
90 *Virginis.* 6.1.88, 6.2.
92 " 6.1.88, 6.1.
93 " 6.1.88, 5.6; 6.3.88, 5.5; 5.23.89, 5.3. Estimates of this red star range from 5.2 to 5.6. Variable?
53 *Corvi.* 5.23.89, 6.45.
95 *Virginis.* Always seen fainter than at Cordoba.
96 " 6.3.88, 6.85.
336 *Hydræ.* 5.18.89, 6.7. Has apparently brightened from 7.0 to 6.7.
97 *Virginis.* 5.18.89, 6.65.
98 " 6.1.88, 6.8; 6.3.88, 6.55; 6.4.88, 6.5; 6.11.88, 6.5; 5.23.89, 6.75. Difficult; no good comparison-stars near; estimates vary from 6.4 to 6.8.
337 *Hydræ.* 6.1.88, 6.6. Estimates range from 6.55 to 6.85.
102 *Virginis.* 6.1.88, 6.8; 6.3.88, 6.95. Estimates range from 6.8 to 7.1.
... *Hydræ.* 5.18.89, 7.3. Observations apparently show a progressive fading from 6.9 in 1884 to 7.3 in 1889.
112 *Virginis.* 6.1.88, 6.55.
113 " 6.29.88, 6.8.
114 " 5.6.88, 6.45; 6.1.88, 6.3; red.
115 " 6.3.88, 4.55; 6.29.88, 4.65. Estimates range from 4.4 to 4.8.
117 *Virginis.* 6.29.88, 5.3.
120 " 6.1.88, 5.75; 6.29.88, 5.65.
122 " 6.1.88, 7.0.

123 *Virginis.* 6.1.88, 7.0.
126 " 6.1.88, 6.85.
128 " 6.1.88, 7.0.
131 " Always seen brighter than at Cordoba.
138 " 6.1.88, 6.85.
139 " 5.6.88, 5.75; 6.1.88, 5.65. Gould, variable? My five estimates of this red star range only from 5.65 to 5.8, and furnish no evidence of variability.
140 *Virginis.* 5.15.87, 6.45; 6.1.88, 6.45; 6.3.88, 6.4. Estimates discordant, and range from 6.2 to 6.6; but always seen fainter than at Cordoba.
141 *Virginis.* 6.29.88, 6.75.
143 " 6.29.88, 6.0.
146 " 6.3.88, 6.0; 6.29.88, 6.05. Has apparently brightened from 6.4 to 6.0.
148 *Virginis.* 6.1.88, 5.1. Gould, variable? No evidence of change furnished by my four observations, which range only from 5.0 to 5.1.
346 *Hydræ.* 6.2.88, 6.95.
149 *Virginis.* 6.29.88, 7.15. Always seen fainter than 7.0.
154 " 5.15.87, 6.45; 5.6.88, 6.45; 6.1.88, 6.45; 6.3.88, 6.3. Gould, variable? My seven observations furnish no evidence of change; red. See note, A. J., No. 184.
156 *Virginis.* 6.29.88, 6.2.
157 " 5.15.87, 5.2; 6.3.88, 5.3; red.
158 " 6.1.88, 5.95.
159 " 6.20.86, 5.8.
161 " 6.1.88, 7.0.
164 " Difficult; always seen fainter than 7.0. Variable?
165 *Virginis.* 6.20.86, 6.2; 5.6.88, 6.1; 6.3.88, 6.0. Gould, variable. My twenty observations range only from 6.0 to 6.3, and give but slight evidence of change. See note, A. J., No. 184.
166 *Virginis.* 6.3.88, 7.25; 6.29.88, 7.15. Generally seen fainter than 7.0.
169 *Virginis.* 6.1.88, 6.15; 6.29.88, 6.2.
351 *Hydræ.* 6.29.88, 5.75.
353 " Always seen as 7½.
354 " 6.2.88, 6.3.
355 " 6.29.88, 6.55.
173 *Virginis.* 6.20.86, 5.7.
356 *Hydræ.* 6.29.88, 6.55.
179 *Virginis.* 6.3.88, 6.3.
180 " 5.23.87, 5.8.
186 " 6.29.88, 6.9.
358 *Hydræ.* Discovered to be variable from my observations of 1888 and 1889. Period about one year; very red. See A. J., No. 204.
190 *Virginis.* 6.8.88, 5.6; 6.29.88, 5.4.
360 *Hydræ.* 6.29.88, 6.75.
195 *Virginis.* 6.29.88, 7.05. Estimates range from 6.7 to 7.0.
... *Hydræ.* 6.4.88, 7.0. Not in U. A. Gould, 18888, 7.2.
196 *Virginis.* 6.3.88, 6.8; 6.29.88, 6.9.
198 " 6.3.88, 5.7; 6.29.88, 5.75.
201 " 6.8.87, 7.0; 6.3.88, 7.0. Estimates range from 6.7 to 7.0.
362 *Hydræ.* 6.2.88, 6.95.
... " 6.2.88, 7.7. Always seen brighter than at Cordoba.
363 *Hydræ.* 6.2.88, 6.4; 6.3.88, 6.5. Estimates vary from 6.4 to 6.7.
364 *Hydræ.* 6.3.88, 7.0; 6.29.88, 6.7. Estimates range from 6.7 to 7.0.
203 *Virginis.* 6.29.88, 6.9.
204 " 5.23.87, 6.45; 6.3.88, 6.55; 6.29.88, 6.65.
... *Hydræ.* 6.2.88, 7.05. Not in U. A. Gould, 19022, 7½.
367 *Hydræ.* 6.4.88, 6.0.
207 *Virginis.* 6.3.88, 6.55; 6.4.88, 6.75; 6.29.88, 6.65.
208 " 6.3.88, 6.55. Always seen fainter than at Cordoba.
210 *Virginis.* 6.3.88, 6.75; 6.29.88, 6.45.
211 " 6.29.88, 7.0; 5.18.89, 6.9. Estimates range progressively from 6.7 to 7.0.
212 *Virginis.* 6.29.88, 6.75.
214 " 6.4.88, 6.8; 6.29.88, 6.65.
368 *Hydræ.* 6.2.88, 3.55; red.
215 *Virginis.* 6.29.88, 6.75.
216 " 6.29.88, 6.8.
... " 6.9.90, 7.0. Not in U. A.
218 " 6.8.87, 7.0.
219 " 5.23.87, 5.6; 6.8.88, 5.6; red; generally 5.6; but once as 5.3.
369 *Hydræ.* 6.8.88, 6.9.
223 *Virginis.* 6.8.88, 4.6. Always seen fainter than at Cordoba.
224 *Virginis.* 6.4.88, 6.25.
372 *Hydræ.* 6.8.88, 6.25.
226 *Virginis.* 6.8.88, 5.85.
229 " 6.8.88, 6.75.
230 " 5.14.87, 6.2; 5.23.87, 6.3; 5.6.88, 6.5; 6.1.88, 6.4; 6.4.88, 6.4; 7.3.88, 6.4. Gould, variable? Estimates range from 6.1 to 6.6, and apparently confirm variability; but further watching is necessary to completely establish this fact. See note, A. J., No. 184.
232 *Virginis.* 6.8.88, 7.1; 7.3.88, 6.85.
236 " 7.3.88, 6.2.
373 *Hydræ.* 6.4.88, 7.05.
374 " 6.4.88, 6.25.
237 *Virginis.* Always seen brighter than at Cordoba.
238 " 5.6.88, 5.8; 6.4.88, 5.7. Gould, variable? My observations furnish no evidence of change.
239 *Virginis.* 6.30.86, 6.3; 5.6.88, 6.45; 6.1.88, 6.4; 6.4.88, 6.45. Gould, variable? No evidence of variation furnished from my observations. See note, A. J., No. 184.

241 *Virginis.* 6.1.88, 7.0; 6.4.88, 6.9.
375 *Hydræ.* 5.14.87, 5.0; 6.2.88, 5.1; 6.4.88, 5.15; once observed as faint as 5.5.
242 *Virginis.* 6.4.88, 6.85.
376 *Hydræ.* 6.4.88, 7.05.
1 *Libræ.* 6.4.88, 6.55.
243 *Virginis.* 5.23.87, 6.6; 6.4.88, 6.75. Estimates range from 6.6 to 6.9.
... *Libræ.* 6.4.88, 6.9.
2 " 6.8.88, 6.75.
3 " 6.4.88, 5.8; 6.8.88, 5.65; 6.11.88, 5.6.
4 " 6.4.88, 6.65.
377 *Hydræ.* 6.4.88, 7.05.
6 *Libræ.* 6.4.88, 6.8.
378 *Hydræ.* 6.4.88, 6.95.
379 " 6.2.88, 5.1; 6.3.88, 4.9; 6.4.88, 4.9; 7.6.88, 4.95. Estimates range from 4.6 to 5.1.
245 *Virginis.* 6.8.88, 6.35; 7.3.88, 6.5.
7 *Libræ.* 6.4.88, 6.65.
246 *Virginis.* 6.30.86, 5.3; 5.23.87, 5.25; 6.2.88, 5.3; 6.4.88, 5.25; 6.8.88, 5.15; 7.3.88, 5.15. Gould, variable. Of my nine observations, only one, the first, made in 1882, is discordant, 5.6; the others range only from 5.15 to 5.35, and furnish but slight evidence of change. See A. J., No. 184.
8 *Libræ.* 6.4.88, 6.9.
247 *Virginis.* 6.8.88, 6.05; 7.3.88, 6.1.
249 " 6.8.88, 6.65; 7.3.88, 6.75.
250 " 5.23.87, 6.25; 6.4.88, 6.25.
251 " 6.8.88, 6.95; 7.3.88, 6.9.
... " 6.8.88, 7.2; 7.3.88, 7.15.
380 *Hydræ.* 5.14.87, 7.2; 6.8.88, 7.1; 7.6.88, 6.85. Generally seen below 7.0.
381 *Hydræ.* 6.8.88, 7.1; 7.6.88, 6.85.
12 *Libræ.* 6.2.88, 6.0; 6.8.88, 5.95; 6.11.88, 5.95.
255 *Virginis.* 6.8.88, 3.85; 7.3.88, 4.15. Estimates range from 3.85 to 4.2.
15 *Libræ.* 5.23.87, 6.25; 6.10.87, 6.2; 6.13.87, 6.25; 6.8.88, 6.15; 6.11.88, 6.3. Once estimated as 6.5; but generally 6.15 to 6.3.
16 *Libræ.* 6.13.87, 6.7; 6.4.88, 6.75; 6.11.88, 6.75.
17 " 6.6.88, 6.75; 6.11.88, 6.65. Always seen brighter than at Cordoba.
18 *Libræ.* 5.23.87, 6.55; 6.10.87, 6.7; 6.13.87, 6.45; 6.24.87, 6.65; 6.8.88, 6.55; 6.11.88, 6.55; 7.6.88, 6.7. Two observations in 1882 and 1884 agree with Cordoba estimates, 6.4; since which our numerous estimates are quite discordant, ranging from 6.45 to 6.8.
386 *Hydræ.* 6.2.88, 5.9; 6.8.88, 6.2.
19 *Libræ.* 7.6.88, 6.75.
21 " 5.23.87, 6.15; 6.8.88, 6.1; 6.11.88, 6.2.
22 " 6.13.87, 5.55; 6.4.88, 5.5; 6.11.88, 5.5. Always estimated brighter than at Cordoba.
23 *Libræ.* 6.8.88, 6.15; 7.6.88, 6.15.
387 *Hydræ.* 6.4.88, 4.6.
25 *Libræ.* 7.3.88, 6.2. Very difficult; near bright star; estimates range from 6.2 to 6.6.
261 *Virginis.* 6.8.87, 6.65; 6.4.88, 6.45; 6.8.88, 6.45; 7.6.88, 6.5. Always seen fainter than at Cordoba; estimates range from 6.4 to 6.7.
29 *Libræ.* 7.3.88, 6.5.
388 *Hydræ.* 6.2.88, 7.25; 6.8.88, 7.3. Always seen below 7.2, although Gould has 7.0.
30 *Libræ.* 6.8.88, 5.85; 6.11.88, 5.8.
31 " 7.3.88, 6.05.
390 *Hydræ.* 7.6.88, 6.9.
391 " 6.3.88, 6.5; 6.8.88, 6.4.
32 *Libræ.* 6.11.88, 5.8.
33 " 6.27.87, 6.15.
392 *Hydræ.* 6.2.88, 6.0.
... *Libræ.* 6.11.88, 6.9.
36 " 6.11.88, 6.5.
37 " 6.8.88, 6.2. Always seen brighter than at Cordoba.
39 *Libræ.* 6.8.88, 6.3; 7.6.88, 6.25. Always seen fainter than at Cordoba.
41 *Libræ.* Always observed as 7.1.
45 " 6.10.87, 3.7; 6.8.88, 3.85; 7.6.88, 3.8. Difficult; estimates range from 3.6 to 4.2; red.
... *Libræ.* 7.6.88, 7.0.
47 " 6.9.88, 6.55; 7.6.88, 6.5.
48 " 6.4.88, 5.75.
49 " 6.4.88, 6.75. Difficult; near bright star.
51 " 7.6.88, 6.25.
53 " 6.4.88, 6.8.
56 " 7.6.88, 6.8. Double.
57 " 7.3.88, 6.45.
59 " 6.10.87, 6.2; 6.13.87, 6.25; 6.4.88, 6.25; 6.9.88, 6.2. Six observations range only from 6.15 to 6.25; but once estimated as 6.5.
60 *Libræ.* 6.4.88, 6.7.
1 *Serpentis Cap.* 6.9.88, 6.8; 7.6.88, 6.9. Estimates have progressively decreased from 6.6 to 6.9.
63 *Libræ.* 6.8.88, 6.8.
3 *Serpentis Cap.* 6.9.88, 6.0.
65 *Libræ.* 6.27.87, 2.8.
6 *Serpentis Cap.* 6.9.88, 6.55; 7.6.88, 6.5; red.
8 " " 6.9.88, 6.85.
66 *Libræ.* 6.9.88, 6.9.
67 " 6.9.88, 7.1. Generally seen below 7.0.
68 " 6.26.86, 6.65; 6.4.88, 6.55.
70 " 7.3.88, 6.1. This star has apparently brightened from 6.4 in 1884 to 6.1 in 1888.
71 *Libræ.* 7.6.88, 6.0.
10 *Serpentis Cap.* 6.9.88, 6.65.
73 *Libræ.* 7.6.88, 6.9.
75 " 7.6.88, 6.35. Generally 6.3 or 6.4; but once estimated as 6.1.
12 *Serpentis Cap.* 6.9.88, 6.3.

77 *Libræ.* 6.4.88, 6.25; 6.11.88, 5.85; 7.3.88, 6.15. Estimates discordant, and range from 5.85 to 6.25. Variable?
79 *Libræ.* 6.27.87, 6.6; 6.9.88, 6.6.
80 " 6.26.86, 7.1; 6.4.88, 6.8.
82 " 6.4.88, 6.45; 6.11.88, 6.1; 7.3.88, 6.15. Generally estimated as 6.1 or 6.15; but once seen as 6.45.
84 *Libræ.* 7.3.88, 5.9.
85 " 7.3.88, 6.85.
86 " 7.6.88, 6.6.
87 " 6.4.88, 5.75; 7.3.88, 5.75.
88 " 6.9.88, 6.05. The estimates of this red star are discordant, ranging from 5.7 to 6.2. Variable?
90 *Libræ.* 6.27.87, 5.6; 6.9.88, 5.75.
91 " 6.27.87, 6.85; 7.3.88, 6.8.
92 " 6.11.88, 4.45; 7.6.88, 4.5.
93 " 6.20.86, 4.15; 6.9.88, 4.0. Estimates range from 3.95 to 4.3.
94 *Libræ.* 6.9.88, 6.45; 7.6.88, 6.35. Estimates vary from 6.35 to 6.65.
95 *Libræ.* 6.4.88, 7.0; 7.6.88, 7.2. Generally observed fainter than 7.0.
19 *Serpentis Cap.* 7.6.88, 6.8.
96 *Libræ.* 6.4.88, 6.5.
97 " 6.27.87, 6.7. Difficult; near bright star.
98 " 6.9.88, 3.7; 7.6.88, 3.95.
99 " 6.27.87, 6.4; 6.4.88, 6.5. Estimates range from 6.3 to 6.6.
101 *Libræ.* 7.3.88, 6.0.
102–3 " 6.9.88, 6.2.
104 " 7.6.88, 6.65; 7.7.88, 6.7.
106 " 6.4.88, 5.45; 7.3.88, 5.75; red. Estimates range from 5.35 to 5.75.
107 *Libræ.* 6.27.87, 6.9; 6.9.88, 6.9; 6.11.88, 6.8.
109 " 6.27.87, 5.7; 6.9.88, 5.75.
24 *Serpentis Cap.* 6.9.88, 5.8.
111 *Libræ.* Difficult; no good comparison-stars near.
1 *Scorpii.* 5.25.87, 7.1; 6.14.87, 7.2; 6.8.88, 7.1. Generally seen below 7.0.
27 *Serpentis Cap.* 6.27.87, 3.4.
2 *Scorpii.* 6.14.87, 5.3; 7.7.88, 5.3.
3 " 6.14.87, 5.1; 7.7.88, 5.1.
4 " 6.14.87, 5.9; 7.7.88, 5.9.
5 " 7.7.88, 6.0.
6 " 6.6.86, 6.8; 6.14.87, 6.6; 7.3.88, 6.6. Generally 6.6 or 6.8; but once observed as 7.0.
7 *Scorpii.* 6.26.86, 6.55; 5.25.87, 6.5; 6.14.87, 6.6; 7.3.88, 6.7; 7.7.88, 6.65. Estimates range from 6.5 to 6.8.
116 *Libræ.* 6.25.88, 6.5; 7.6.88, 6.4; 8.29.88, 6.4.
8 *Scorpii.* 6.26.86, 6.25; 6.14.87, 6.4; 7.7.88, 6.3.
9 " 6.9.88, 4.4.
117 *Libræ.* 6.9.88, 6.4; 6.11.88, 6.6.
118 " 6.9.88, 6.4; 6.11.88, 6.35; 7.6.88, 6.45.
11 *Scorpii.* 6.14.87, 5.9; 6.18.87, 5.9; 7.3.88, 6.1; 7.7.88, 6.1; red.
119 *Libræ.* 6.9.88, 5.15.
12 *Scorpii.* 6.4.86, 2.9; 6.30.86, 3.35; 5.25.87, 3.15; 6.9.88, 3.1; 7.3.88, 3.1. Estimates range from 2.9 to 3.4.
13 *Scorpii.* 6.4.86, 2.4; 6.9.88, 2.6; 7.3.88, 2.6. Estimates range from 2.3 to 2.6.
121 *Libræ.* 6.9.88, 6.1; 7.3.88, 6.0. Generally seen as 6.0 or 6.1; but once estimated as 5.8.
122 *Libræ.* 6.27.87, 5.9; 6.9.88, 5.9. Estimates discordant, and range from 5.8 to 6.3. Variable?
1 *Ophiuchi.* 6.27.87, 7.1; 6.9.88, 7.0; 7.3.88, 7.1.
15 *Scorpii.* 5.27.87, 5.85; 6.14.87, 5.9; 7.7.88, 5.75. Estimates range from 5.6 to 5.95.
16 *Scorpii.* 6.14.87, 6.85; 6.18.87, 6.9.
17 " 6.9.88, 4.55.
18 " 6.4.86, 2.6.
37 *Serpentis Cap.* 9.8.87, 7.0; 6.9.88, 7.1; 7.3.88, 7.1.
19 *Scorpii.* 6.14.87, 6.45; 6.18.87, 6.4; 6.9.88, 6.4; 7.3.88, 6.5. Estimates range from 6.2 to 6.5.
2 *Ophiuchi.* 9.8.87, 6.8; 6.9.88, 6.8.
3 " 6.9.88, 6.9.
20 *Scorpii.* 6.5.86, 4.4; 6.9.88, 4.55.
21 " 6.5.86, 4.7; 6.20.86, 4.65; 6.12.87, 4.75; 6.9.88, 4.55; 7.3.88, 4.75. Estimates range from 4.3 to 4.75.
22 *Scorpii.* 6.2.88, 6.5; 6.3.88, 6.6.
24 " 6.18.87, 6.7.
25 " 6.12.87, 6.25; 6.13.87, 6.25; 6.14.87, 6.25; 6.9.88, 6.35. Six observations range only from 6.25 to 6.35; but once estimated as bright as 5.9; red.
26 *Scorpii.* 6.9.88, 6.1.
27 " 6.18.87, 6.3; 6.9.88, 6.2.
29 " 8.27.89, 6.9.
32 " 6.18.87, 6.9.
43 *Serpentis Cap.* 9.8.87, 6.2. Always estimated fainter than at Cordoba.
36 *Scorpii.* 6.26.87, 6.15; 6.2.88, 5.9; 6.4.88, 5.9; 6.9.88, 6.2. The estimates of this red star (a suspected variable from the Cordoba observations) range from 5.9 to 6.3, yet furnish no positive evidence of change.
38 *Scorpii.* 6.5.86, 4.25; 6.12.87, 4.15. Estimates range from 3.9 to 4.25.
39 *Scorpii.* 6.9.88, 5.35.
41 " 6.14.87, 6.7; 6.18.87, 6.7.
5 *Ophiuchi.* 9.8.87, 6.7; 6.9.88, 6.9. The estimates progressively decrease from 6.6 in 1884 to 6.9 in 1888.
44 *Scorpii.* 6.9.88, 5.75; red.
6 *Ophiuchi.* 9.8.87, 7.2; 6.9.88, 7.1. Generally seen below 7.0.
46 *Scorpii.* 6.18.87, 6.4.
48 " 6.2.88, 6.3. Gould, variable. No evidence of change furnished from my four observations.
50 *Scorpii.* 6.18.87, 6.9.

47 *Serpentis Cap.* 6.29.88, 7.2. Always seen fainter than 7.0.
8 *Ophiuchi.* 9.8.87, 6.9; 6.9.88, 6.9. Generally 6.9; but once seen as 6.6.
. . . *Scorpii.* 7.1.89, 7.4; 8.27.89, 7.3.
. . . " 7.1.89, 7.5; 8.27.89, 7.4.
59 " 6.14.87, 5.2; 6.2.88, 5.45; 6.3.88, 5.2; 6.4.88, 5.2; 6.9.88, 5.1. Estimates of this red star vary from 4.9 to 5.45; but generally 5.2.
61 *Scorpii.* 6.4.86, 3.5; 6.3.86, 3.5; 6.9.88, 3.55; red.
63 " Always seen below 7.0.
10 *Ophiuchi.* 9.8.87, 6.6.
11 " 6.14.87, 5.05; 6.9.88, 4.95.
67 *Scorpii.* 6.13.87, 5.9; 6.14.87, 5.95.
12–13 *Ophiuchi.* 6.9.88, 4.75.
14 " 9.8.87, 7.1; 6.11.88, 7.0. Generally seen below 7.0.
15 *Ophiuchi.* 6.13.87, 4.9; 6.14.87, 4.65; 6.2.88, 5.05; 6.3.88, 4.95; 6.4.88, 4.95; 6.9.88, 4.9. Gould, variable? My nine estimates range from 4.6 to 5.05; yet I see no reason to suspect variation.
17 *Ophiuchi.* 6.9.88, 5.9; red.
20 " 6.13.87, 6.75.
70 *Scorpii.* 6.14.87, 5.1; 6.9.88, 4.95. Always estimated brighter than at Cordoba.
. . . *Ophiuchi.* 6.13.87, 7.0; 7.1.89, 7.0; 8.27.89, 7.0. Not in U. A. Gould, 22338, 7⅔; SDM. 10°, 4327, 7.0.
23 *Ophiuchi.* 6.13.87, 6.7; 6.9.88, 6.65.
24 " 6.9.88, 4.65.
26 " 6.9.88, 4.7.
75 *Scorpii.* 6.4.86, 3.2; 6.9.88, 3.35.
. . . *Ophiuchi.* 6.9.88, 6.95; 6.30.89, 6.9; 8.27.89, 6.9. Gould, 22477, 7½; SDM. 16°, 4270, 6.8. Not in U. A.
30 *Ophiuchi.* 9.8.87, 6.3; 6.9.88, 6.2.
31 " 9.8.87, 6.95; 6.9.88, 6.95.
32 " 6.11.88, 7.0.
34 " 6.11.88, 6.6.
33 " 6.9.88, 6.8.
35 " 6.9.88, 6.8.
82 *Scorpii.* 6.11.88, 6.95.
36 *Ophiuchi.* 6.11.88, 6.3. Difficult; no good comparison-stars near.
37 *Ophiuchi.* 6.11.88, 7.05.
39 " 6.12.87, 5.4; 6.13.87, 5.35; 6.14.87, 5.5. Estimates range from 5.2 to 5.6.
88 *Scorpii.* 6.11.88, 6.95.
89 " 6.11.88, 6.75.
90 " 6.11.88, 6.45.
92 " 6.11.88, 7.05.
47 *Ophiuchi.* 6.9.88, 6.75; 6.11.88, 6.8.
49 " 6.14.87, 5.15. Generally 5.15 or 5.2; but once estimated as 4.8.
54 *Ophiuchi.* 6.11.88, 6.3.
57 " 6.11.88, 6.8.
59 *Ophiuchi.* 9.9.87, 6.9; 9.10.87, 6.85; 6.11.88, 6.9. Generally 6.8 or 6.9; but once estimated as 6.5.
62 *Ophiuchi.* 6.11.88, 6.6.
68 " 6.11.88, 6.75.
70 " Gould, variable. I have over forty observations of this star (not given in detail), and not the slightest evidence of variability is furnished; red. See A. J., No. 184.
78 *Ophiuchi.* 6.11.88, 6.95.
82 " 6.11.88, 6.0.
80 " 6.11.88, 6.6.
84 " 6.11.88, 6.5.
85 " 6.11.88, 6.55.
86 " 6.11.88, 6.25; 6.29.88, 6.2.
89 " 6.11.88, 7.0.
90 " 9.16.87, 2.6.
91 " 7.6.88, 6.7; 9.28.88, 6.8. Always seen fainter than at Cordoba.
93 *Ophiuchi.* 6.11.88, 6.9; 9.27.88, 6.95; 9.28.88, 6.95.
94 " 6.11.88, 6.65.
95 " 6.11.88, 6.35; 9.28.88, 6.3.
98 " 6.11.88, 6.9; 9.27.88, 6.95; 9.28.88, 6.95.
99 " 6.11.88, 6.95; 9.27.88, 6.95; 9.28.88, 6.95.
106 " 6.27.88, 6.95; 6.28.88, 6.95.
107 " 9.24.88, 7.05; 9.28.88, 7.15. Generally seen below 7.0.
. . . *Ophiuchi.* 9.28.88, 7.05. Not in U. A. Gould, 23408, 7.4.
110 *Ophiuchi.* Discovered to be a remarkable variable of the Algol type in 1881. Period, $0^d\ 20^h\ 7^m\ 41^s.6\ E - 0^s.0002\ E^2$; limits of variation, 6.0 to 6.7.
114 *Ophiuchi.* 9.28.88, 6.9.
115 " 10.8.88, 6.8.
116 " 9.26.88, 6.9; 9.28.88, 69.
118 " 9.24.88, 6.6.
122 " 7.6.88, 6.6.
124 " 7.6.88, 4.75. Generally seen brighter than at Cordoba.
1 *Serpentis Cau.* 6.29.88, 4.45.
125 *Ophiuchi.* 10.8.88, 6.9; red; difficult.
126 " 7.6.88, 3.7; 9.28.88, 3.75. Difficult; no good comparison-stars near.
127 *Ophiuchi.* 6.29.88, 7.2. Difficult; near bright star; yet always seen below 7.0.
128 *Ophiuchi.* 9.26.88, 5.9; red.
131 " 9.24.88, 6.55.
3 *Serpentis Cau.* 10.8.88, 6.8.
132 *Ophiuchi.* 7.6.88, 6.4; 9.28.88, 6.35.
133 " 7.3.88, 6.45.
135 " 7.6.88, 4.7; red.
136 " 9.28.88, 6.6.
139 " 9.28.88, 4.7.
140 " 6.11.88, 6.55; 6.29.88, 6.5; 7.3.88, 6.6. Very difficult; near bright star. Estimates very discordant, and range from 6.3 to 7.0.

141 *Ophiuchi.* 6.29.88, 4.65. Always seen fainter than at Cordoba.

4 *Serpentis Cau.* 10.8.88, 6.8.

5 " " 9.24.88, 6.65; 9.28.88, 6.45.

146 *Ophiuchi.* 6.29.88, 5.55. Generally seen as 5.5; but once estimated as 5.8.

147 *Ophiuchi.* 6.29.88, 6.8.

149 " 9.24.88, 5.15. Gould, variable? My four observations are accordant, and furnish no evidence of change.

150 *Ophiuchi.* 11.9.87, 5.75.

151 " 7.6.88, 6.0; 9.24.88, 6.2. Difficult; estimates range from 5.9 to 6.3.

153 *Ophiuchi.* 9.26.88, 5.8.

6 *Serpentis Cau.* 9.24.88, 5.7.

7 " " 9.24.88, 6.85.

8 " " 7.6.88, 3.95.

9 " " 9.10.87, 6.65; 9.16.87, 6.7; 6.29.88, 6.6; 9.24.88, 6.65. Difficult; near bright star. Estimates discordant, and range from 6.5. to 6.9.

157 *Ophiuchi.* 7.3.88, 4.7.

10 *Serpentis Cau.* 9.24.88, 6.25.

158 *Ophiuchi.* 7.6.88, 6.65. Always seen brighter than at Cordoba.

162 *Ophiuchi.* 7.6.88, 6.7; 9.24.88, 6.55.

11 *Serpentis Cau.* 7.6.88, 4.45.

163 *Ophiuchi.* 9.16.87, 6.7; 6.11.88, 6.55. Always seen brighter than at Cordoba.

165 *Ophiuchi.* 9.28.88, 5.4.

166 " 9.24.88, 6.9; 9.28.88, 7.2. Difficult.

1 *Sagittarii.* 9.24.88, 6.85.

12 *Serpentis Cau.* 10.13.87, 6.8; 10.15.87, 6.8; 10.17.87, 6.75; 9.24.88, 6.65. Observations discordant, and range from 6.4 to 6.8.

3 *Sagittarii.* 7.10.88, 6.75.

13 *Serpentis Cau.* 9.24.88, 6.15.

4 *Sagittarii.* 9.16.87, 6.6; 6.11.88, 6.65. Four estimates very accordant, 6.6 or 6.65; yet once observed as 6.9.

5 *Sagittarii.* 9.16.87, 7.1; 6.11.88, 7.0; 9.24.88, 6.95; 9.26.88, 7.05. Generally seen below 7.0.

7 *Sagittarii.* 10.19.86, 7.2; 9.16.87, 7.0; 6.11.88, 6.85; 9.24.88, 6.95; 9.26.88, 7.05. Observations very discordant, and range from 6.45 to 7.2. Variable?

175 *Ophiuchi.* 7.6.88, 6.95; 9.24.88, 6.4; 9.28.88, 6.6; 9.29.88, 6.65; 10.8.88, 6.45. Discovered to be a variable of short period in 1888. (See A. J., No. 210.) From a final discussion of all my observations to the present time (1891), I have adopted the following as the best attainable elements: 1882, September 4.428 Green. M. T. $+ 17^{d}.125641$ E for the epoch of maximum. The minimum occurs earlier by $6^{d}.250$. The variation is about eight tenths of a magnitude, or from 6.2 to 6.95.

178 *Ophiuchi.* 9.16.87, 7.0; 7.6.88, 6.85.

15 *Serpentis Cau.* 6.29.88, 6.8.

8 *Sagittarii.* 7.6.88, 6.45; 10.8.88, 6.5. Difficult; no good comparison-stars near.

9 *Sagittarii.* 10.24.86, 6.65; 7.3.88, 6.95; 9.24.88, 6.65; 9.26.88, 6.65; 9.27.88, 6.65; 9.28.88, 6.65. Generally observed as 6.6 or 6.65; but twice estimated as faint as 6.95. Variable?

10 *Sagittarii.* 6.11.88, 6.05; 9.24.88, 5.95.

11 " 7.6.88, 7.0; 7.10.88, 6.95.

16 *Serpentis Cau.* 9.28.88, 6.0.

183 *Ophiuchi.* 7.6.88, 5.7.

13 *Sagittarii.* 10.19.86, 6.4; 9.16.87, 6.2; 6.11.88, 6.25; 9.24.88, 6.2. Generally 6.2 or 6.3; but once estimated as bright as 5.95.

14 *Sagittarii.* 9.24.88, 5.6.

186 *Ophiuchi.* 9.16.87, 3.6.

16 *Sagittarii.* 10.24.86, 6.75; 7.3.88, 6.75. Estimates range from 6.6 to 6.9.

187 *Ophiuchi.* 9.10.87, 6.35; 7.6.88, 6.4. Always seen fainter than at Cordoba.

18 *Sagittarii.* 9.24.88, 7.0.

21 " 7.10.88, 6.35; 9.28.88, 6.35.

... " 7.10.88, 7.2.

19 " 7.10.88, 6.9.

194 *Ophiuchi.* 9.16.87, 6.8; 6.29.88, 6.85; 7.6.88, 6.85. Estimates quite discordant, and range from 6.6 to 7.1.

24 *Sagittarii.* 10.13.87, 6.1; 7.10.88, 6.6; 9.24.88, 6.4. Cum.; difficult; estimates range from 6.1 to 6.6.

23 *Sagittarii.* 10.15.87, 6.8; 6.10.88, 6.8; 8.27.89, 7.2; 9.19.89, 7.0. Difficult. Neb.?

28 *Sagittarii.* 9.16.87, 3.0; 7.3.88, 3.3. Gould, variable; red. The estimates of this bright red star range from 3.0 to 3.4. Difficult; evidence of change considered slight.

19 *Serpentis Cau.* 6.29.88, 5.8; 9.24.88, 6.1; 9.26.88, 6.1. Difficult; estimates range from 5.8 to 6.2.

20 *Serpentis Cau.* 6.29.88, 5.85; 7.6.88, 6.0.

30 *Sagittarii.* 9.24.88, 6.5.

32 " 10.8.88, 5.95.

34 " 10.15.87, 7.0; 10.17.87, 7.0; 10.19.87, 7.0.

35 " This star was apparently observed in the years 1882 and 1886, and estimated to be 6.9 and 7.1 respectively. A third observation in 1887 found the star to be 8.0. Numerous observations since have invariably found it either 7.9 or 8.0. These discordances would imply variation: but I have a suspicion that a neighboring star, Gould, 24685, 7^{m}, was mistaken for 35 *Sagittarii* in the case of the observations of 1882 and 1886, and this star may also have been observed at Cordoba. It should receive further attention. Var.?

37 *Sagittarii.* 10.22.88, 5.9; 10.25.88, 5.95.

40 " 7.10.88, 5.7. Difficult; red.

25 *Serpentis Cau.* 9.15.87, 7.0; 10.12.87, 7.0; 7.10.88, 6.9; 8.22.89, 6.95. This star has apparently faded from 6.6 in 1882 to 7.0 in 1887.

26 *Serpentis Cau.* 9.15.87, 6.7; 7.10.88, 6.75.

42 *Sagittarii.* 7.3.88, 6.1; red.

43 " 7.3.88, 5.7.

44 " 7.10.88, 6.15; 9.24.88, 6.2. Always estimated brighter than at Cordoba by nearly half a magnitude.

45 *Sagittarii.* 7.10.88, 6.3. This star also observed brighter than at Cordoba.

27 *Serpentis Cau.* 9.15.87, 6.7; 7.10.88, 6.7; 8.22.89, 6.6. Estimates range from 6.4 to 6.7.

49 *Sagittarii.* 9.26.88, 6.7. Estimates vary from 6.4 to 6.7.

50 *Sagittarii.* 10.19.86, 6.6; 7.3.88, 6.65; 7.10.88, 6.5. Estimates range from 6.3 to 6.65.

51 *Sagittarii.* 9.16.87, 5.15; 7.10.88, 5.2; red. Difficult; no good comparison-stars near.

52 *Sagittarii.* 11.5.87, 6.95; 7.10.88, 6.9.

28 *Serpentis Cau.* 9.15.87, 6.5; 7.10.88, 6.55.

29 " " 9.24.88, 6.6.

... *Sagittarii.* 9.24.88, 6.95.

30 *Serpentis Cau.* 9.26.88, 6.95. Cum.

... *Sagittarii.* 9.24.88, 6.9. Difficult.

31 *Serpentis Cau.* 8.29.88, 6.75. Neb.; estimates range from 6.55 to 6.9.

54 *Sagittarii.* 7.3.88, 3.0; red; always estimated fainter than at Cordoba.

56 *Sagittarii.* 10.13.87, 6.9; 7.10.88, 6.7; 10.8.88, 6.9. Gould, variable from 6 to 7½. My observations furnish no evidence of change.

57 *Sagittarii.* Discovered to be a variable of short period in 1886. Dr. Chandler's latest elements give for the epoch of maximum, 1886, September $25^d.31 + 5^d.7690$ E. The variation is from 5.8 to 6.6.

34 *Serpentis Cau.* 11.9.87, 3.5.

3 *Scuti.* 8.29.88, 5.05; 10.8.88, 5.4; 10.24.88, 5.05. Estimates range from 5.0 to 5.4.

36 *Serpentis Cau.* 10.12.87, 6.55; 10.15.87, 6.7; 10.17.87, 6.65; 10.19.87; 6.55; 7.16.88, 6.45; 10.30.88, 6.8; 10.31.88, 6.8; 8.22.89, 6.55. The eleven estimates of this star are quite discordant, ranging from 6.4 to 6.8. Variable?

65 *Sagittarii.* 10.19.86, 5.4; 9.16.87, 5.4; 10.13.87, 5.35; 7.10.88, 5.3; very red. Estimates range from 4.95 to 5.4. Should be further watched.

67 *Sagittarii.* 7.3.88, 3.1; red. Always estimated fainter than at Cordoba.

5 *Scuti.* 8.29.88, 6.8.

73 *Sagittarii.* 10.8.88, 6.8. Difficult.

7 *Scuti.* 8.29.88, 6.55.

74 *Sagittarii.* 9.16.87, 6.0; 7.10.88, 6.3. Estimates range from 6.0 to 6.3.

8 *Scuti.* 8.30.88, 6.7.

76 *Sagittarii.* 10.13.87, 5.2; 7.10.88, 5.2. Estimates range from 5.0 to 5.4, and always seen brighter than at Cordoba.

9 *Scuti.* 8.29.88, 5.9.

... " 9.22.89, 7.0; 10.16.89, 7.0. Not in U. A. SDM. 14°, 5098, 7.0.

48 *Serpentis Cau.* 8.30.88, 6.25.

10 *Scuti.* 10.24.86, 6.45; 9.14.87, 6.25; 10.17.87, 6.25; 10.19.87, 6.25; 8.29.88, 6.4; 9.26.88, 6.3; very red; difficult. Eight observations range only from 6.25 to 6.45; but once estimated as 6.0.

78 *Sagittarii.* 7.10.88, 6.1; red.

11 *Scuti.* 10.12.87, 6.1; 10.17.87, 6.1; 10.19.87, 6.1; 8.29.88, 6.2. Estimates range from 6.0 to 6.3 and always seen brighter than at Cordoba.

80 *Sagittarii.* 10.13.87, 6.8; red.

13 *Scuti.* 9.14.87, 5.75; 8.29.88, 5.5. Estimates range from 5.35 to 5.8. Variable?

14 *Scuti.* 9.14.87, 3.7; 8.30.88, 3.8; 9.26.88, 3.6. Gould, variable. Estimates range from 3.55 to 4.0; but difficult to observe.

81 *Sagittarii.* 7.10.88, 6.35. Neb. Always seen fainter than at Cordoba.

15 *Scuti.* 8.29.88, 6.65.

86 *Sagittarii.* 7.10.88, 6.2.

87 " 7.10.88, 7.0.

17 *Scuti.* 10.24.86, 6.8; 9.10.87, 6.6; 9.14.87, 6.5; 10.12.87, 6.65; 10.19.87, 6.65; 8.30.88, 6.4; 9.22.89, 6.6; red. Estimates are very discordant. ranging from 6.25 to 6.9. Variable?

88 *Sagittarii.* 10.30.88, 6.45.

18 *Scuti.* 10.24.86. 6.9; 9.14.87, 6.6; 8.29.88, 6.65; 8.22.89, 6.7. Estimates range from 6.55 to 6.9.

19 *Scuti.* 9.14.87, 5.1; 8.30.88, 5.05; 9.26.88, 4.95.

89 *Sagittarii.* 7.10.88, 7.0.

20 *Scuti.* 8.30.88, 6.65.

21 " 9.14.87, 5.35; 8.29.88, 5.2; 8.30.88, 5.35; 9.26.88, 5.05; 10.30.88, 5.15; 9.22.89, 5.3. Estimates quite discordant, and range from 5.05 to 5.55. Variable?

92 *Sagittarii.* 7.10.88, 7.0.

22 *Scuti.* 8.30.88, 6.75.

94 *Sagittarii.* 10.13.87, 6.1; 11.9.87, 6.05; 7.10.88, 5.9.

95 " 7.16.84, 3.2; 9.16.87, 3.2; 7.3.88, 3.2; 9.26.88, 3.45. Estimates range from 3.1 to 3.5. It is always seen brighter than at Cordoba.

96 *Sagittarii.* 7.10.88, 6.75. From 6.45 in 1882, this star apparently faded to 6.75 in 1888.

97 *Sagittarii.* 10.13.87, 7.0; 7.10.88, 7.0. Difficult.

1 *Aquilæ.* 10.12.87, 7.05.

98 *Sagittarii.* 7.10.88, 7.0.

99 " 10.19.86, 6.15; 9.10.87, 5.7; 9.15.87, 5.8; 10.13.87, 5.65; 7.10.88, 5.65. The estimates of this red star are discordant, and range from 5.65 to 6.25. Variable?

24 *Scuti.* 10.12.87, 4.6; 9.26.88, 4.5. Four estimates vary only from 4.5 to 4.7; yet this star was once estimated as bright as 4.15.

27 *Scuti.* 10.30.88, 6.5; 9.22.89, 6.55.

103 *Sagittarii.* 10.15.87, 6.45; 10.17.87, 6.55; 10.19.87, 6.45. The first observation of this star, made in 1882, agrees with the Cordoba results, 6.8; but subsequent observations, five in number, all made in 1887, invariably make the star one third of a magnitude brighter.

104 *Sagittarii.* 10.18.88, 5.8; 10.24.88, 5.8. Gould, variable? My estimates, five in number, range from 5.5 to 5.8; but do not furnish sufficient corroborative evidence of change; further observations desirable.

27 *Scuti.* 10.30.88, 6.5; 9.22.89, 6.55.

4 *Aquilæ.* 11.9.87, 6.5.

105 *Sagittarii.* 9.15.87, 6.7; 7.10.88, 6.7.

28 *Scuti.* 10.12.87, 6.8.

29 " 8.30.88, 6.4.

. . . *Aquilæ.* 10.22.86, 7.5; 11.22.86, 7.15; 10.12.87, 7.3; 8.30.88, 7.5; 8.22.89, 7.5. Estimates range from 7.1 to 7.5; difficult; near another star.

106 *Sagittarii.* 9.15.87, 6.95; 7.10.88, 6.9.

108 " 7.10.88, 6.5; red.

31 *Scuti.* 8.30.88, 6.75.

110 *Sagittarii.* 9.15.87, 6.4; 9.16.87, 6.45; 7.10.88, 6.5. Always estimated much fainter than at Cordoba.

111 *Sagittarii.* 9.15.87, 4.9.

112 " 7.16.84, 2.3; 7.3.88, 2.6. The estimates of this bright star range from 2.2 to 2.6.

113 *Sagittarii.* 9.15.87, 5.2; red.

114 " 8.29.88, 5.8; 8.30.88, 5.8; 10.25.88, 5.7.

116 " 9.15.87, 6.05; 10.12.87, 6.05; 7.10.88, 6.1. Estimates range from 6.05 to 6.4.

117 *Sagittarii.* 8.29.88, 7.0. This star is not on the charts, although in the catalogue.

119 *Sagittarii.* 10.19.86, 5.1; 9.10.87, 5.0; 9.14.87, 5.0; 9.16.87, 4.9; 10.13.87, 5.3; 8.29.88, 5.3. Always observed brighter than at Cordoba. Estimates discordant, and range from 4.9 to 5.5. Variable?

120 *Sagittarii.* 9.26.88, 3.75; 9.30.88, 3.75; 9.22.89, 3.6.

33 *Scuti.* 10.12.87, 5.15; 8.30.88, 5.35; 9.26.88, 5.3; 8.22.89, 5.4. The estimates of this red star range from 5.1 to 5.5. Variable?

123 *Sagittarii.* 9.15.87, 6.25; 7.10.88, 6.4. Always seen brighter than at Cordoba.

124 *Sagittarii.* 8.29.88, 7.1.

128 " 10.19.86, 6.8; 9.15.87, 6.7; 7.10.88, 6.95. Estimates vary from 6.6 to 7.0.

130 *Sagittarii.* 7.16.84, 2.6; 9.16.87, 2.7; 7.3.88, 2.8. The estimates of this bright star range from 2.6 to 3.0.

9 *Aquilæ.* 9.14.87, 4.0; 9.26.88, 4.15; red.

10 " 10.15.87, 6.8; 10.24.88, 6.85. Generally 6.8; but once estimated as faint as 7.1.

11 *Aquilæ.* 8.30.88, 5.6; 9.26.88, 5.7.

135 *Sagittarii.* 9.15.87, 7.15; 7.10.88, 6.95. Usually seen below 7.0.

136 *Sagittarii.* 9.26.88, 4.0.

137 *Sagitarii.* 9.29.88, 6.9.

15 *Aquilæ.* 10.19.86, 6.0; 10.22.86, 6.0; 9.14.87, 5.75; 9.26.88, 5.85; 8.30.88, 5.75; red. Estimates discordant, and range from 5.55 to 6.0.

138 *Sagittarii.* 10.30.88, 5.95.

139 " 7.16.84, 3.6; 7.3.88, 3.5; red.

17 *Aquilæ.* 10.24.88, 7.3. This star does not appear on the charts, although in the catalogue; it has always been estimated below 7.0. Decl. +9° 27'.3, instead of −9° 27'.3. See list of errata, A. N., No. 2377, column 8.

18 *Aquilæ.* 10.24.88, 7.1. Always seen as 7.1.

19 " 9.14.87, 3.45; 10.12.87, 3.3; 8.30.88, 3.4; 9.26.88, 3.35; 10.25.88, 3.4. Difficult; estimates range from 3.0 to 3.6.

140 *Sagittarii.* 9.29.88, 6.7; red.

141 " 8.29.88, 6.25. Always seen fainter than at Cordoba.

142 *Sagittarii.* 10.25.88, 6.7. Gould, variable? Estimates range from 6.5 to 6.8.

21 *Aquilæ.* 10.12.87, 7.1. Generally seen below 7.0.

143 *Sagittarii.* 9.6.88, 6.6.

147 " 9.26.88, 3.1.

149 " 9.26.88, 6.7; 9.29.88, 6.6.

150 " 9.29.88, 6.4.

26 *Aquilæ.* 10.12.87, 7.0; 9.26.88, 7.0.

151 *Sagittarii.* 9.17.87, 7.05; 9.6.88, 7.0. Estimates range from 6.8 to 7.2.

28 *Aquilæ.* 9.26.88, 5.9.

154 *Sagittarii.* 9.29.88, 7.1; 10.3.88, 6.95.

. . . *Aquilæ.* 9.26.88, 7.0; 9.27.89, 6.8. Not in U. A. Gould, 26360, 7½; SDM. 8°, 4900, 6.9.

155 *Sagittarii.* 9.30.88, 5.45.

158 " 9.26.88, 7.05; 9.29.88, 7.05; 10.3.88, 6.95.

31 *Aquilæ.* 10.12.87, 6.9; 9.26.88, 6.9.

160 *Sagittarii.* 9.17.87, 5.0; 10.12.87, 5.4; 10.15.87, 5.35; 10.17.87, 5.35; 9.6.88, 5.4; red. Estimates discordant, and range from 5.0 to 5.4.

. . . *Sagittarii.* 10.18.88, 6.85.

161 " Always seen fainter than at Cordoba; difficult.

. . . *Sagittarii.* Out of place on chart; always seen fainter than at Cordoba.

35 *Aquilæ.* 10.22.86, 5.9; red.

36 " 9.26.88, 6.9.

165 *Sagittarii.* 9.6.88, 5.7.

170 " 9.26.88, 7.0.

38 *Aquilæ.* 9.26.88, 5.7.

39 " 10.3.88, 6.75.

171 *Sagittarii.* 9.26.88, 6.9.

174 " 9.30.88, 4.0; 10.3.88, 4.1. Estimates range from 4.0 to 4.45.

175 *Sagittarii.* 9.6.88, 6.55.

176 " 9.30.88, 4.85.

41 *Aquilæ.* 9.26.88, 6.8.

43 *Aquilæ.* 9.26.88, 6.7.

181 *Sagittarii.* 9.26.88, 5.4; 9.30.88, 5.3.

182 " 10.22.86, 6.0; 10.24.86, 6.1; 9.15.87, 6.0; 9.20.87, 6.05; 9.26.88, 5.9. Gould, variable? Seven observations of this red star, extending from 1886 to 1888, range only from 5.9 to 6.1; yet it was estimated once in 1882 as bright as 5.6. Evidence of variability considered very slight. See A. J., No. 184.

184 *Sagittarii.* 10.22.86, 6.25; 10.24.86, 6.3; 9.26.88, 6.05; 9.30.88, 6.15. Always estimated fainter than at Cordoba.

45 *Aquilæ.* 9.26.88, 6.7.

187 *Sagittarii.* 10.8.88, 5.9.

188 " 10.8.88, 6.8.

47 *Aquilæ.* 10.22.86, 5.2; 10.24.86, 5.35; 11.22.86, 5.35. Estimates range from 5.0 to 5.35.

190 *Sagittarii.* 9.30.88, 7.0. Difficult; no good comparison-stars near.

191 *Sagittarii.* 10.8.88, 6.85.

50 *Aquilæ.* Discovered to be a variable of the η *Aquilæ* type in 1886. The star varies from about 6.3 to 7.3. Dr. Chandler's latest elements give for the epoch of maximum, 1886, September, 20.0, $+7^d.033$ E.

52 *Aquilæ.* 9.26.88, 6.8.

54 " 9.26.88, 5.6; red.

202 *Sagittarii.* 9.26.88, 6.85; red.

203 " 9.6.88, 6.9.

59 *Aquilæ.* 9.26.88, 5.65; red.

204 *Sagittarii.* 9.30.88, 6.0. Gould, variable, 5¼ to 6¾. Difficult to observe, as it lies near a bright star; yet my four observations are accordant, and furnish no evidence of change.

207 *Sagittarii.* 10.19.86, 4.8; 9.17.87, 4.5; 9.6.88, 4.6; 9.26.88, 4.6. Estimates vary from 4.5 to 4.95.

208 *Sagittarii.* 9.6.88, 6.1.

209 " 10.20.86, 6.0; 10.22.86, 6.1; 10.24.86, 6.0; 9.15,87, 6.15; 9.6.88, 6.0; red. Always seen fainter than at Cordoba.

... *Sagittarii.* 9.26.88, 7.1.

64 *Aquilæ.* 10.22.86, 4.7; 9.17.87, 4.55; 9.26.88, 4.75. Gould, variable? Difficult; my estimates range from 4.3 to 4.8; yet a careful inspection furnishes no positive evidence of variability.

212 *Sagittarii.* 11.14.86, 5.6; 9.15.87, 5.6; 9.26.88, 5.65.

65 *Aquilæ.* 10.24.86, 5.7; 9.17.87, 5.75; 10.12.87, 5.75; 10.17.87, 5.75; 9.26.88, 5.7. Estimates range from 5.5 to 6.0; will bear further watching.

217 *Sagittarii.* 9.26.88, 6.5; 9.30.88, 6.6. Difficult; near another star.

218 *Sagittarii.* 9.15.87, 6.2; 9.26.88, 6.2.

219 " 9.26.88, 6.8.

221 " 9.6.88, 5.6; red.

70 *Aquilæ.* 9.26.88, 6.1. Always seen fainter than at Cordoba.

223 *Sagittarii.* 9.26.88, 6.85.

225 *Sagittarii.* 9.6.88, 5.45.

226 " 9.6.88, 5.75; 9.26.88, 5.65.

77 *Aquilæ.* 9.27.88, 6.5.

230 *Sagittarii.* 9.6.88, 6.85.

231 " 9.30.88, 6.8.

233 " 9.6.88, 6.25.

234 " 9.30.88, 7.0.

82 *Aquilæ.* 10.3.88, 5.7.

239 *Sagittarii.* 9.26.88, 7.0; 9.30.88, 7.0. Usually seen below 7.0.

238 *Sagittarii.* 10.24.86, 6.3; 9.17.87, 6.35; 9.26.88, 6.35. Generally seen fainter than at Cordoba.

89 *Aquilæ.* Gould, variable. Difficult; yet my three estimates, 1886–88, are accordant.

247 *Sagittarii.* 9.30.88, 6.8.

248 " 10.22.86, 5.0; 10.24.86, 5.05; 11.14.86, 4.9; 9.6.88, 4.9; 9.26.88, 5.0.

95 *Aquilæ.* 9.27.88, 5.8.

97 " 9.27.88, 6.5.

250 *Sagittarii.* 10.19.86, 5.15; 10.22.86, 4.8; 10.24.86, 4.75; 11.14.86, 4.85; 9.6.88, 5.0; 9.26.88, 5.05; red; estimates range from 4.7 to 5.15. Variable?

253 *Sagittarii.* 9.6.88, 5.15.

255 " 10.22.86, 5.4; 10.24.86, 5.35; 11.14.86, 5.1; 9.6.88, 5.15; 9.26.88, 5.05.

261 *Sagittarii.* 9.26.88, 6.75.

102 *Aquilæ.* 10.12.87, 6.95; 9.27.88, 7.0.

264 *Sagittarii.* 9.26.88, 6.05; red.

265 " 10.19.86, 5.25; 10.22.86, 4.5; 10.24.86, 4.6; 11.14.86, 5.0; 9.17.87, 4.85; 9.6.88, 4.75; 9.26.88, 4.8. The estimates of this red star are very discordant, and range from 4.4 to 5.25; yet variability is not suspected.

104 *Aquilæ.* 11.9.87, 6.5; 9.27.88, 6.6.

269 *Sagittarii.* 9.26.88, 6.5.

273 " 10.22.86, 7.1; 11.14.86, 7.1; 9.17.87, 7.2; 9.26.88, 7.15. Generally seen below 7.0.

106 *Aquilæ.* 9.27.88, 6.1.

108 " 9.26.88, 6.55; 9.27.88, 6.65.

274 *Sagittarii.* 9.27.88, 6.65.

... *Aquilæ.*[1] This star is on the chart, but not in the catalogue. Gould, 27507, 8^m; SDM. 4°, 5010, 7.3.

110 *Aquilæ.* 9.27.88, 6.75.

... *Aquilæ.*[1] 9.27.89, 6.9. This star is also on the chart, but not in catalogue. Gould, 27533, 7.1; SDM. 4°, 506, 7.2.

2 *Capricorni.* 10.12.87, 6.55; 9.27.88, 6.5. The estimates progressively brighten from 6.75 in 1882 to 6.5 in 1888.

118 *Aquilæ.* 11.9.87, 6.85; 9.27.88, 6.95.

3 *Capricorni.* 9.27.88, 6.8; 9.30.88, 6.7. Difficult.

4 " 9.17.87, 6.2; 10.12.87, 6.25; 9.26.88, 6.2; 9.27.88, 6.3. Six estimates vary only from 6.15 to 6.25; but observed once as faint as 6.5.

[1] To be erased from maps. List of errata, A. N., No. 2377, column 10.

121 *Aquilæ.* 9.27.88, 6.95.

122 " 11.9.87, 7.1; 9.27.88, 7.05.

5 *Capricorni.* 8.5.83, 6.2; 8.24.83, 6.2; 8.26.83, 6.2; 10.22.86, 5.9; 10.24.86, 6.1; 9.27.88, 6.0. Gould, variable? My nine comparisons of this red star range from 5.85 to 6.2; yet its variability is very doubtful; further observations are desirable. See A. J. No. 184.

282 *Sagittarii.* 9.27.88, 6.6.

6 *Capricorni.* 9.27.88, 6.8; 9.30.88, 6.6. Difficult.

7 " 10.13.87, 6.15; 9.27.88, 6.0.

... *Aquilæ.* 9.27.88, 6.9. Not in U. A. Gould, 27787, 7$\frac{1}{4}$; SDM. 3°, 4838, 7.2.

8 *Capricorni.* 9.26.88, 4.5.

11 " 10.19.86, 5.9; 10.22.86, 5.95; 10.24.86, 5.9; 11.18.86, 5.9; 9.17.87, 5.9; 10.13.87, 5.9; 9.27.88, 5.75; red. Generally estimated as 5.9; but once each estimated as 5.5 and 5.6.

131 *Aquilæ.* 10.3.88, 6.45; red.

12 *Capricorni.* 10.12.87, 5.0; 10.15.87, 5.15; 9.26.88, 5.15.

13 *Capricorni.* 9.17.87, 6.85; 10.12.87, 6.8; 9.27.88, 6.8. Difficult; near bright star; estimates range from 6.8 to 7.1.

296 *Sagittarii.* 10.19.86, 6.25.

135 *Aquilæ.* 10.12.87, 6.15; 9.27.88, 6.3; 10.3.88, 6.25. Gould, variable? My six estimates give values for the magnitude ranging from 6.1 to 6.5; yet variability is not suspected; will bear further watching.

137 *Aquilæ.* 9.27.88, 6.5.

17 *Capricorni.* 9.17.87, 5.65; 9.26.88, 5.55; 9.27.88, 5.5.

138 *Aquilæ.* 9.27.88, 6.5.

... *Capricorni.* 9.27.88, 7.15.

20 " 10.13.87, 6.75; 9.27.88, 6.85.

22 " 9.26.88, 5.15; 9.27.88. 5.35; 9.30.88, 5.25.

... " 10.13.87, 7.4. Estimates vary from 7.0 to 7.4.

139 *Aquilæ.* 9.16.87, 6.0; 9.27.88, 6.3.

23 *Capricorni.* 9.27.88, 6.9. Difficult; near bright star.

24 " 9.27.88, 6.6; red.

140 *Aquilæ.* 9.27.88, 7.0.

25 *Capricorni.* 9.26.88, 6.0; 9.27.88, 5.75.

141 *Aquilæ.* 9.27.88, 5.2.

3 *Microscopium.* 10.19.86, 6.5; 9.27.88, 6.5. Generally seen as 6.4 or 6.5; but once estimated as faint as 6.8.

26 *Capricorni.* 11.16.89, 7.5. Gould, variable 6$\frac{3}{4}$–8$\frac{1}{2}$. If the right star has been observed, it has always been seen as 7.5.

5 *Microscopium.* 9.16.88, 7.0; 9.27.88, 7.0.

29 *Capricorni.* 10.13.87, 6.0.

7 *Microscopium.* 9.27.88, 6.95.

30 *Capricorni.* 11.27.86, 6.9; 10.13.87, 6.9.

31 " 10.13.87, 6.4.

143 *Aquilæ.* 11.2.87, 6.9; 11.5.87, 6.95.

32 *Capricorni.* 10.22.86, 6.3; 10.24.86, 6.3; 11.18.86, 6.3; 9.17.87, 6.4; 10.13.87, 6.35; 9.27.88, 6.25. Estimates range from 6.1 to 6.5.

33 *Capricorni.* 10.13.87, 7.0. This has maintained the magnitude 7.0 unchanged during the period from 1882 to 1887. Gould, 6.8.

144 *Aquilæ.* 9.16.87, 5.55; 9.27.88, 5.4. Always seen fainter than at Cordoba.

35 *Capricorni.* 9.17.87, 6.55; 9.27.88, 6.5. Generally seen as 6.5 or 6.6; but once estimated as 6.8.

37 *Capricorni.* 10.13.87, 7.05. Generally seen below 7.0.

145 *Aquilæ.* 10.3.88, 6.6; 10.8.88, 6.45; 10.25.88, 6.45.

... " 9.27.88, 7.3.

39 *Capricorni.* 9.26.88, 5.55; 9.27.88, 5.5.

41 " 10.13.87, 5.9; 9.27.88, 5.85; red. Estimates range from 5.6 to 5.9.

3 *Aquarii.* 9.28.88, 5.4; 10.3.88, 5.5.

42 *Capricorni.* 10.3.88, 6.65.

43 " 10.13.87, 6.2; red.

4 *Aquarii.* 9.18.87, 7.0; 10.12.87, 6.9.

" 9.27.88, 6.8; 10.3.88, 6.8. Always seen brighter than at Cordoba.

44 *Capricorni.* 10.3.88, 6.65.

5 *Aquarii.* 9.27.88, 7$\frac{3}{4}$ estimated; 9.28.88, 8.0. This star is not on the chart, although in the Catalogue. It was apparently observed in 1882, and estimated to be 6.95, since which it has not been estimated brighter than 7.3. In all probability it is variable.

6 *Aquarii.* 10.12.87, 7.5; 9.28.88, 7.4. For this star my estimates are quite discordant, the various determinations, five in number, varying through half a magnitude, and strongly suggesting variability.

46 *Capricorni.* 9.28.88, 7.0.

47 " 10.19.86, 4.0; 10.22.86, 4.1; 10.24.86, 4.0; 11.18.86, 4.15; 11.26.86, 4.2; 9.17.87, 4.0; 9.28.88, 4.15. Nine estimates give values for the magnitude ranging only from 4.0 to 4.2; yet it was once estimated as faint as 4.7.

8 *Aquarii.* 10.3.88, 3.9. Difficult.

9 " 10.3.88, 4.8; red.

51 *Capricorni.* 10.3.88, 6.95.

52 " 10.22.86, 5.95; 10.24.86, 6.05; 11.18.86, 5.9; 11.26.86, 6.2; 10.19.87, 6.1; red. Estimates range from 5.9 to 6.2.

53 *Capricorni.* 10.13.87, 6.55; 9.27.88, 6.6.

11 *Aquarii.* 9.27.88, 6.4.

30 *Microscopium.* 10.19.87, 6.85; 9.27.88, 6.75.

56 *Capricorni.* 10.22.86, 4.35; 11.18.86, 4.3; 11.26.86, 4.5; 10.13.87, 4.35; red. Always estimated fainter than at Cordoba.

12 *Aquarii.* 9.27.88, 6.25.

13 " Gould, variable? Our three estimates are quite accordant, 5.65 and 5.7, and furnish no evidence of change.

58 *Capricorni.* 10.3.87, 6.45; 9.28.88, 6.7.

34 *Microscopium.* Estimates progressively fade from 6.6 in 1884 to 6.85 in 1888.

16 *Aquarii.* 10.3.88, 4.85.

15 " 10.3.88, 6.65.

35 *Microscopium.* 10.19.87, 6.7; 9.27.88, 6.75; red.

17 *Aquarii.* 10.12.87, 7.05; 9.27.88, 6.8; 10.3.88, 7.05. Six estimates of this star range from 6.8 to 7.1; generally seen below 7.0.

18 *Aquarii.* 10.12.87, 6.65.

61 *Capricorni.* 10.22.86, 6.35; 10.24.86, 6.45; 11.18.86, 6.25; 9.27.88, 6.05; 10.3.88, 6.25. Estimates vary from 6.05 to 6.45.

20 *Aquarii.* 10.12.87, 7.1; 9.27.88, 6.8; 10.3.88, 7.05. Generally seen below 7.0.

21 *Aquarii.* 10.3.88, 6.5.

63 *Capricorni.* 11.26.86, 6.05; 9.17.87, 5.95; 10.19.87, 6.0.

24 *Aquarii.* 9.27.88, 6.05. Gould, variable? Our four estimates range only from 5.85 to 6.05, and furnish but slight evidence of change.

64 *Capricorni.* 10.22.86, 6.25; 10.24.86, 6.15; 11.18.86, 6.1; 9.27.88, 6.05. Six estimates range only from 6.05 to 6.25; yet the star was once estimated as bright as 5.75.

27 *Aquarii.* 12.17.86, 6.0; 9.28.88, 6.25.

29 " 11.15.89, 6.7.

30 " 12.17.86, 6.4; 9.28.88, 6.3.

31 " 9.28.88, 6.3.

32 " 10.12.87, 6.85; 9.28.88, 6.8; 11.15.89, 6.7.

67 *Capricorni.* 11.26.86, 6.2; 10.19.87, 6.3; 10.13.87, 6.2. Estimates vary from 6.1 to 6.5.

33 *Aquarii.* 10.12.87, 7.05. Always seen slightly fainter than 7.0.

46 *Microscopium.* 10.19.87, 6.55.

68 *Capricorni.* 11.26.86, 5.0; 9.28.88, 5.0; 9.29.88, 5.1; 9.30.88, 5.05; red.

69 *Capricorni.* Always seen below 7.0.

70 " 11.26.86, 3.9; 9.28.88, 3.9; 9.30.88, 4.0.

73 " 11.18.86, 4.6; 11.26.86, 4.95; 9.17.87, 4.9; 10.13.87, 5.0; 9.28.88, 4.95. The observations of this red star are discordant, ranging from 4.6 to 5.0; yet variability is not suspected.

40 *Aquarii.* 10.15.87, 6.75.

39 " 9.18.87, 7.2; 10.15.87, 7.2; 9.29.88, 7.05. Generally estimated fainter than 7.0.

76 *Capricorni.* 11.26.86, 5.4; 9.29.88, 5.45; 9.30.88, 5.45.

77 " 10.13.87, 7.0.

45 *Aquarii.* 10.15.87, 6.9.

50 " 9.18.87, 6.55; 10.15.87, 6.6. Generally seen as 5.5 or 5.6; but once estimated as 5.8.

58. *Microscopium.* 9.29.88, 5.9.

51 *Aquarii.* 10.3.88, 6.8; 10.8.88, 6.7.

79 *Capricorni.* 10.13.87, 6.45; 10.15.87, 6.65; 10.2.87, 6.65; 11.5.87, 6.55; 11.12.87, 6.45; 9.29.88, 6.5; 10.3.88, 6.5; 9.23.89, 6.4; 9.24.89, 6.4. The estimates of this star are quite discordant, ranging from 6.2 to 6.75. Variable?

... *Aquarii.* 10.30.88, 7.0; 12.6.88, 7.1. Not in U. A. Gould, 29163, 7^m; SDM. 3°, 5160, 7.0.

80 *Capricorni.* 11.26.86, 5.65; 9.29.88, 5.6; 9.30.88, 5.6; red.

82 *Capricorni.* 9.30.88, 5.4.

58. *Aquarii.* 10.15.87, 5.7.

84 *Capricorni.* 10.13.87, 6.8; 9.29.88, 6.9. Usually seen as 6.8 or 6.9; but once estimated as bright as 6.6.

66 *Microscopium.* 10.13.87, 6.7; 10.3.88, 6.7.

86 *Capricorni.* 11.14.86, 4.5; 11.18.86, 4.55; 11.26.86, 4.4; 9.29.88, 4.45; 9.30.88, 4.35; red.

63 *Aquarii.* 12.2.88, 7.0. Estimates range from 6.8 to 7.2.

87 *Capricorni.* 11.22.86, 6.0; 9.29.88, 6.1; 9.30.88, 6.1.

66 *Aquarii.* 10.3.88, 6.65. Always seen brighter than at Cordoba.

65 *Aquarii.* 10.3.88, 6.35. Always estimated fainter than at Cordoba.

88 *Capricorni.* 10.13.87, 6.8; 9.29.88, 6.9. Generally seen as 6.8 or 6.9; but once estimated as 6.6.

89 *Capricorni.* 10.22.86, 6.6; 11.22.86, 6.7; 9.18.87, 6.8; 10.13.87, 6.75; 9.29.88, 6.6. For this red star the estimates vary from 6.4 to 6.8; but generally seen as 6.6 or 6.7, and brighter than at Cordoba.

90 *Capricorni.* 9.29.88, 5.85; 9.30.88, 5.9; red.

67 *Aquarii.* 10.15.87, 5.55.

68 " 10.3.88, 5.9. Has apparently faded from 5.65 in 1882 to 5.9 in 1888.

92 *Capricorni.* 9.29.88, 6.9.

71 *Aquarii.* 12.21.86, 6.7; 9.18.87, 6.75; 9.29.88, 6.75.

70 " 10.15.87, 5.65.

72 " 10.15.87, 6.5.

93 *Capricorni.* 11.18.86, 3.8; 11.26.86, 3.9; 9.30.88, 3.9.

73 *Aquarii.* 9.29.88, 6.95.

94 *Capricorni.* 11.22.86, 6.35; 9.29.88, 6.25; 9.30.88, 6.3; red.

95 *Capricorni.* 9.29.88, 6.85.

96 " 9.29.88, 6.95. Estimates vary from 6.95 to 7.2.

98 *Capricorni.* 9.29.88, 4.65; 9.30.88, 4.7.

1 *Piscis Austrini.* 10.3.88, 6.5. Difficult; low.

99 *Capricorni.* 10.13.87, 7.1; 9.29.88, 7.05; red.

102 " 10.3.88, 7.05. Difficult.

75 *Aquarii.* 10.2.86, 2.9; 11.18.86, 2.8; 11.22.86, 2.8; 11.24.86, 2.9; 11.27.86, 2.8; 10.15.87, 2.85; red. Estimates range from 2.55 to 2.9.

104 *Capricorni.* 11.22.86, 7.2; 9.18.87, 7.15; 10.13.87, 7.15; 9.29.88, 7.05. Estimates range from 6.6 to 7.2. Variable?

77 *Aquarii.* 10.3.88, 6.8.

106 *Capricorni.* 10.15.87, 6.7. This red star has always been estimated brighter than at Cordoba, the reverse generally being the case as regards red stars.

107 *Capricorni.* 10.15.87, 6.55; 9.29.88, 6.65.

108 *Capricorni.* 9.30.88, 4.6.
. . . " 10.22.86, 7.4; 11.22.86, 7.25; 9.29.88, 7.4. Always estimated fainter than at Cordoba.
83 *Aquarii.* 10.3.88, 6.75.
110 *Capricorni.* 11.26.86, 3.5; 11.27.86, 3.7; 9.30.88, 3.65.
12 *Piscis Austrini.* 10.3.88, 6.7.
111 *Capricorni.* 9.18.87, 5.7; 9.29.88, 5.6; 9.30.88, 5.55.
113 " 9.29.88, 5.1; 9.30.88, 4.9; red.
85 *Aquarii.* 10.15.87, 6.0; 9.29.88, 6.0.
114 *Capricorni.* 10.8.88, 6.4.
115 " 9.29.88, 6.05; 9.30.88, 6.1.
117–8 " 9.15.87, 5.3.
119 " 9.30.88, 6.7.
120 " 10.15.87, 6.45.
121 " 9.30.88, 5.8.
122 " 11.22.86, 7.1; 9.29.88, 6.9; 9.30.88, 6.9; 10.3.88, 6.95. Estimates range from 6.9 to 7.2.
123 *Capricorni.* 11.18.86, 2.65; 11.22.86, 2.7; 11.24.86, 2.7; 11.27.86, 2.6; 9.18.87, 2.9. Estimates are discordant, and range from 2.4 to 2.9.
87 *Aquarii.* 10.15.87, 7.15; 9.29.88, 6.95; 10.3.88, 6.8; 10.8.88, 6.9. Estimates for this red star vary from 6.8 to 7.15.
. . . *Aquarii.* 10.30.88, 7.5; 12.2.88, 7.4.
124 *Capricorni.* 10.15.87, 6.55; 9.29.88, 6.45; 9.30.88, 6.4.
128 " 10.3.88, 6.35.
91 *Aquarii.* 10.15.87, 6.6; 9.29.88, 6.7.
92 " 10.15.87, 6.7; 9.29.88, 6.8.
93 " 10.15.87, 7.0; 9.29.88, 6.95.
130 *Capricorni.* 9.30.88, 5.4.
131 " 10.15.87, 6.45.
94 *Aquarii.* 10.15.87, 6.0; 9.29.88, 6.1.
95 " 10.15.87, 6.45; 9.29.88, 6.55.
133 *Capricorni.* 10.3.88, 6.6; 10.30.88, 6.8.
96 *Aquarii.* 10.15.87, 6.4; 9.29.88, 6.5.
98 " 10.15.87, 6.45; 9.29.88, 6.55.
102 " 11.26.86, 5.85; 10.15.87, 5.8; 9.29.88, 5.75.
103 " 11.24.86, 4.8; 11.26.86, 4.7. Generally seen as 4.7 or 4.8; but once estimated as faint as 5.1.
104 *Aquarii.* 10.15.87, 5.65.
105 " 11.18.86, 2.8; 11.22.86, 2.8; 11.24.86, 2.7; 11.27.86, 2.8; 9.18.87, 3.0; 10.15.87, 2.7; 10.10.88, 2.75. Nine estimates of this bright red star range only from 2.7 to 3.0; yet it was once estimated as bright as 2.1.
106 *Aquarii.* 10.15.87, 7.1; 9.29.88, 6.95.
107 " 12.17.86, 4.05; 12.20.86, 4.05; 9.18.87, 4.0; 10.15.87, 4.15. Six of the seven estimates of this star make it 4.1, or one third of a magnitude brighter than at Cordoba; yet it was once estimated as faint as 4.6.
112 *Aquarii.* 10.3.88, 6.0; 10.8.88, 5.7; 10.25.88, 6.0; 12.2.88, 5.95. Estimates somewhat discordant, and range from 5.7 to 6.0.
114 *Aquarii.* 9.30.88, 6.7.
116 *Aquarii.* 10.3.88, 6.8.
120 " 12.17.86, 6.3; 10.15.87, 6.1; 9.29.88, 6.3. Gould, variable? My estimates range from 6.1 to 6.5; yet variability is not suspected.
33 *Piscis Austrini.* 9.29.88, 6.3.
121 *Aquarii.* 10.15.87, 6.7.
34 *Piscis Austrini.* 9.29.88, 5.95; red.
35 " " 9.29.88, 5.6; 10.8.88, 5.7. This star has apparently faded from 5.4 in 1884 to 5.7 in 1888.
123 *Aquarii.* 11.24.86, 5.9.
125 " 9.30.88, 6.7.
36 *Piscis Austrini.* 9.29.88, 6.55.
. . . *Aquarii.* Always seen fainter than at Cordoba by one third of a magnitude.
127 *Aquarii.* 9.29.88, 5.85.
130 " 10.3.88. 6.1. Always seen brighter than at Cordoba.
131. *Aquarii.* 11.26.86, 6.2; 10.15.87, 6.2; 10.10.88, 6.1. This star has always been found brighter than at Cordoba.
132 *Aquarii.* 10.3.88, 6.7.
133 " 9.29.88, 6.3.
134 " 10.20.86, 5.4; 10.3.88, 5.4.
135 " 11.24.86, 5.7; 9.29.88, 5.5; red.
136 " 10.2.86, 3.5; 11.14.86, 3.8; 11.18.86, 3.7; 11.21.86, 3.65; 11.24.86, 3.8; 11.26.86, 3.7; 11.15.87, 3.7. The estimates range from 3.5 to 4.1; but generally seen as 3.7 or 3.8.
138 *Aquarii.* 11.26.86, 6.4.
139 " 11.27.86, 5.7; 10.15.87, 5.85.
140 " 9.29.88, 6.05.
142 " 10.2.86, 4.6; 11.14.86, 4.5; 11.18.86, 4.55; 11.21.86, 4.55; 11.24.86, 4.7; 11.26.86, 4.8; 11.15.87, 4.6. Estimates range from 4.5 to 5.1.
. . . *Aquarii.* 10.31.88, 7.0; 12.2.88, 7.0. Not in U. A. Gould, 30616, $7\frac{3}{4}^m$; SDM. 3°, 5443, 7.2.
147 *Aquarii.* Out of position on chart.
150–51 *Aquarii.* 10.2.86, 3.3; 11.14.86, 3.6; 11.18.86, 3.7; 11.21.86, 3.75; 11.24.86, 3.7; 11.26.86, 3.5. Estimates vary from 3.3 to 3.75.
40 *Piscis Austrini.* 10.15.87, 6.2; 9.29.88, 6.3. Estimates range from 6.0 to 6.3.
154 *Aquarii.* 10.3.88, 4.8. Always estimated brighter than at Cordoba.
155 *Aquarii.* 10.3.88, 6.6.
157 " 10.8.88, 6.2. Has apparently brightened from 6.5 in 1884 to 6.2 in 1888.
156 *Aquarii.* Always seen brighter than at Cordoba.
158 " 9.30.88, 7.0. While the estimates of 1884 and 1888 agree with the magnitude as determined at Cordoba, 7.0, two estimates made in 1886 are fainter, 7.1 and 7.2.
159 *Aquarii.* 10.10.88, 6.7.
161 " 11.24.86, 5.6; 10.3.88, 5.45.
163 " 10.2.86, 3.75; 11.14.86, 3.95; 11.18.86, 3.95;

11.21.86, 3.9; 11.24.86, 4.0; 11.26.86, 3.9. Generally observed brighter than at Cordoba.

166 *Aquarii.* 11.27.86, 5.3; 10.3.88, 5.3. Generally seen as 5.3; but once estimated as bright as 4.9; difficult.

167 *Aquarii.* 12.17.86, 6.4; 9.30.88, 6.55.

48 *Piscis Austrini.* 9.29.88, 6.75.

168 *Aquarii.* 10.10.88, 6.8.

50 *Piscis Austrini.* 9.29.88, 6.45.

169 *Aquarii.* 9.30.88, 6.8.

52 *Piscis Austrini.* Always estimated brighter than at Cordoba.

171 *Aquarii.* 12.20.86, 6.6; 12.25.86, 6.65; 10.15.87, 6.6. Five observations vary only from 6.6 to 6.7; yet the star was once estimated as faint as 6.9, and always seen fainter than at Cordoba.

... *Aquarii.* Estimated as 7.3 at Cordoba; but has always been observed by me as 7.0.

174 *Aquarii.* 12.17.86, 6.45; 9.30.88, 6.2; 10.10.88, 6.35. Generally seen brighter than at Cordoba.

175 *Aquarii.* 12.17.86, 6.4; 9.30.88, 6.5.

176 " 11.24.86, 4.9; 10.10.88, 5.0.

178 " 10.10.88, 6.85.

179 " 11.24.86, 5.45; 10.3.88, 5.65. Estimates range from 5.3 to 5.65.

180 *Aquarii.* 10.3.88, 5.8; red.

57 *Piscis Austrini.* 9.29.88, 6.4.

... *Aquarii.* 10.3.88, 6.65. Double.

181 " 10.3.88, 6.3.

182 " 9.30.88, 7.0.

183 " 11.24.86, 4.5; 12.20.86, 4.5; 12.25.86, 4.5; 10.15.87, 4.65; 10.3.88, 4.5; 10.10.88, 4.5. This red star has generally been estimated as 4.5 or 4.6; but it was estimated once each as bright as 4.0 and 4.2.

60 *Piscis Austrini.* 9.29.88, 6.5.

184 *Aquarii.* 10.15.87, 7.15; 9.30.88, 6.95; 10.10.88, 7.15; 10.25.88, 7.2. Always seen fainter than at Cordoba; estimates range from 6.9 to 7.2.

185 *Aquarii.* 11.14.86, 4.2; 11.18.86, 4.2; 11.21.86, 4.2; 11.24.86, 4.25; 11.26.86, 3.95; 10.19.87, 3.75; 10.25.88, 3.7. The estimates of this red star are very discordant, ranging from 3.6 to 4.25; yet the discordances are doubtless due to its brightness and color, as the extreme estimates occur in two sequences observed on the same evening; further observations, however, are desirable.

187 *Aquarii.* 10.15.87, 5.95.

188 " 9.29.88, 6.9.

191 " 11.22.86, 3.1; 11.24.86, 3.05; 11.27.86, 3.05; 10.15.87, 3.1; 10.25.88, 3.1.

192 *Aquarii.* 9.29.88, 6.7. Always seen fainter than at Cordoba.

194 *Aquarii.* 9.30.88, 6.7.

3 *Piscium.* 9.29.88, 6.15.

195 *Aquarii.* 9.29.88, 5.9.

196 *Aquarii.* 9.30.88, 6.8.

4 *Piscium.* 10.15.87, 6.5; 9.29.88, 6.35. Estimates of this double star are quite discordant, and range from 6.3 to 6.75.

197 *Aquarii.* 9.29.88, 6.7.

7 *Piscium.* 10.10.88, 6.4.

198 *Aquarii.* 11.24.86, 6.7; 12.20.86, 6.65; red. Estimates vary from 6.4 to 6.7.

9 *Piscium.* Always seen fainter than at Cordoba.

10 " 9.29.88, 6.55.

71 *Piscis Austrini.* 9.29.88, 6.05 red. Estimates range from 5.9 to 6.2.

200 *Aquarii.* 9.30.88, 6.6.

201 " 12.20.86, 6.4; 10.15.87, 6.45; 9.29.88, 6.5. Estimates range from 6.35 to 6.7.

202 *Aquarii.* 9.29.88, 6.1.

203 " 12.20.86, 6.65; 10.15.87, 6.75; 10.3.88, 6.85. Estimates range from 6.7 to 7.0.

204 *Aquarii.* 12.20.86, 6.75; 10.15.87, 6.55; 9.29.88, 6.5.

205 " 9.30.88, 6.5.

74 *Piscis Austrini.* 10.3.88, 6.9.

206 *Aquarii.* 9.29.88, 6.75.

75 *Piscis Austrini.* 10.3.88, 6.9. Difficult.

208 *Aquarii.* 11.26.86, 5.55.

209 " 12.20.86, 7.2; 10.3.88, 7.05. Always seen fainter than 7.0; difficult.

... *Aquarii.* 10.3.88, 6.7; 10.10.88, 7.3; 10.25.88, 7.1. Estimates very discordant, varying from 6.7 to 7.3; yet variability is not suspected, as it lies very close to a bright star, and is very difficult to observe.

16 *Piscium.* 9.29.88, 6.65.

... *Aquarii.* 10.31.88, 6.8. Not in U. A. Gould, 31375, $7\frac{1}{2}^m$; SDM. 8°, 6021, 7.0.

210 *Aquarii.* 10.2.86, 4.4; 10.3.86, 4.4; 10.19.86, 4.5; 11.14.86, 4.6; 11.21.86, 4.4; 11.26.86, 4.4; 11.9.87, 4.55; 10.25.88, 4.5.

2 *Sculptoris.* 10.31.88, 5.95.

17 *Piscium.* 9.29.88, 5.3. Always observed brighter than at Cordoba.

211 *Aquarii.* 10.2.86, 3.65; 10.3.86, 3.65; 10.19.86, 3.75; 11.21.86, 3.7; 11.26.86, 3.7; 11.9.87, 3.6; 10.25.88, 3.6.

212 *Aquarii.* 10.2.86, 4.7; 10.3.86, 4.8; 10.19.86, 4.7; 10.21.86, 4.75; 11.14.86, 4.7; 11.26.86, 4.8; 11.9.87, 4.8; 10.25.88, 4.85.

213 *Aquarii.* 10.31.88, 6.7.

4 *Sculptoris.* 10.31.88, 6.65.

215 *Aquarii.* 12.20.86, 4.45; 12.25.86, 4.45; 10.19.87, 4.2; 10.25.88, 4.5. For this red star the estimates range from 4.1 to 4.5.

216 *Aquarii.* 10.31.88, 6.7; red.

5 *Sculptoris.* 10.31.88, 6.75.

218 *Aquarii.* 11.26.86, 4.2; 10.19.87, 4.3; 10.25.88, 4.15; red.

219 " 11.26.86, 5.2; 10.19.87, 5.3; red. Generally seen as 5.2 or 5.3; but once estimated as 5.65.

6 *Sculptoris.* 10.31.88, 6.65.

. . . *Aquarii.* 10.19.87, 6.9. Not in U. A. Gould, 31572, $7\frac{3}{4}^m$; SDM. 16°, 6254, 6.5.

221 *Aquarii.* 12.20.86, 6.45; 11.5.87, 6.45; 11.9.87, 6.55; 10.10.88, 6.35. Difficult.

222 *Aquarii.* 11.24.86, 4.1; 11.26.86, 3.95, 10.19.87, 4.0; 10.25.88, 4.15; red. Estimates vary from 3.95 to 4.35.

9 *Sculptoris.* 10.31.88, 6.65.

223 *Aquarii.* 11.21.86, 4.7; 11.26.86, 4.75; 10.19.87, 4.55; 10.10.88, 4.65; 10.25.88, 4.5. Always seen brighter than at Cordoba.

224 *Aquarii.* 10.31.88, 5.45.

227 " 11.3.88, 6.65.

228 " 10.31.88, 6.4.

11 *Sculptoris.* 10.31.88, 6.0.

229 *Aquarii.* 11.3.88, 6.5.

231 " 10.2.86, 3.95; 10.19.86, 4.1; 11.21.86, 3.95; 11.26.86, 4.0; 11.19.87, 4.0; 10.25.88, 4.0.

24 *Piscium.* 10.31.88, 6.6.

232 *Aquarii.* 10.31.88, 6.85 Generally seen as 6 8 or 6.9, but once estimated as faint as 7.1.

235 *Aquarii.* 10.2.86, 4.7; 10.3.86, 4.7; 10.19.86, 4.5; 11.14.86, 4.5; 11.21.86, 4.6; 11.26.86, 4.6; 11.5.87, 4.6; 11.9.87, 4.55; 10.25 88, 4.5; red. Estimates vary from 4.3 to 4.7.

12 *Sculptoris.* 10.31.88, 6.7.

14 " 11.3.88, 6.85; 12.6.88, 6.6. Always seen fainter than at Cordoba. Estimates range from 6.5 to 6.85.

238 *Aquarii.* 10.31.88, 6.35.

30 *Piscium.* 11.3.88, 6.5; 12.2.88, 6.4.

31 " 10.31.88, 6.6; 11 3.88, 6 5.

239 *Aquarii.* 10.25.88, 6.25; 10.31.88, 6 25.

240 " 10.31.88, 6 8. Estimates vary from 6.5 to 6.8.

241 *Aquarii.* 10.31.88, 6.25.

242 " 10.31.88, 6.4.

15 *Sculptoris.* 10.31.88, 6.5. The first estimate, made in 1884, agrees with the U. A. magnitude 6.7; yet three observations made in the years 1886 to 1888 give very accordantly 6 5.

32 *Piscium.* 11.3.88, 6 45.

243 *Aquarii.* 10.31.88, 6.8.

34 *Piscium.* 10.31.88, 6.7.

244 *Aquarii.* 10.2.86, 4.35; 10.3.86, 4.3; 10 19.86, 4.5, 11.14.86, 4.4; 11.21.86, 4.55; 11 26 86, 4.4, 11.9.87, 4.3; 10.25.88, 4.4.

. . . *Aquarii.* 10.19.87, 7.0. Not in U. A. SDM. 13°, 6428, 6.3.

245 *Aquarii.* 12.20.86, 6.7; 10.19 87, 6 75, 10.31.88, 6.75.

246 " 11.3.88, 6.5.

247 " 10.31.88, 6.9.

20 *Sculptoris.* 11.3.88, 6.35; 12.6.88, 6.4.

254 *Aquarii.* 10.31.88, 7.0.

256 *Aquarii.* 11.3.88, 6.0; red. Difficult; near bright star.

257 *Aquarii.* 10.25.88, 5 0.

258 " 10.25.88, 5.6. Has apparently brightened from 5.9 in 1882 to 5.6 in 1888.

259 *Aquarii.* 11.18.86, 4.5; 11.24.86, 4.5; 11.26.86, 4.5; 10.19.87, 4.65; 10.25.88, 4.7. Estimates range from 4.5 to 4.8.

261 *Aquarii.* 10.25 88, 5.3.

262–3 " 10.25.88, 5.4.

264 " 10.31 88, 5.85

43 *Piscium.* 10.19.87, 5 5; 11.3.88, 5.85; 12.2.88, 5.4; 11.16.89, 5.8. Estimates discordant, ranging from 5.4 to 5.85. Variable?

265 *Aquarii.* 10.22.86, 6.4; 10.19.87, 6.35; 11.3.88, 6.45. Estimates range from 6.4 to 6.8.

27 *Sculptoris.* 12.6.88, 4.65. Difficult.

28 " 11.3.88, 6.75.

266 *Aquarii.* 10.21.86, 6 9

267 " 10.22.86, 6.8.

268 " 10.19.87, 6.15; 10.31.88, 6.1 Always seen fainter than at Cordoba by one third of a magnitude.

269 *Aquarii.* 10.19 87, 6.15; 10.31 88, 5.85. Estimates range from 5.8 to 6.15. Difficult, on account of nearness of following star.

. . . *Aquarii.* Difficult, near preceding star.

1 *Ceti.* 1.3.88, 6 4.

270 *Aquarii.* 10.25.88, 5.2.

271 " 10.31 88, 6.2.

272 " 12.20 86, 7 1; 11 3.88, 7.15. Difficult; no good comparison stars near.

32 *Sculptoris.* 11.3.88, 6.75.

273. *Aquarii.* 10.31.88, 5.75; 1.21.89, 5.8. A progressive fading is apparently shown from 5.4 in 1884 to 5.8 in 1889

50 *Piscium.* 11.3.88, 6.25.

274 *Aquarii.* 11.3.88, 6.25.

52 *Piscium.* 11.3.88, 6.1. Always seen fainter than at Cordoba.

275 *Aquarii.* 10.22.86, 6.8.

276 " 11.3.88, 6.95.

36 *Sculptoris.* 12.2.88, 6.9; 1.1.89, 6.65. Estimates discordant, and range from 6.5 to 6.9.

2 *Ceti.* 11.18.86, 6.8; 11.3.88, 6.9

3 " 11 28.86, 6.7, 11 3.88, 6.4, 12.2.88, 6.55. Always seen brighter than at Cordoba; estimates discordant, ranging from 6.4 to 6.75.

55 *Piscium.* 11.3.88, 4.95.

57 " 11.3 88, 6.7.

. . . " 12.4.88, 7.2. Difficult.

39 *Sculptoris.* 12.2.88, 7.1.

58 *Piscium.* 11.3.88, 4.95.

59 " 11.3.88, 4.5; red.

4 *Ceti.* 11.18.86, 6.65; 11.3.88, 6.3, 12.4.88, 6.4. Al-

ways seen brighter than at Cordoba; estimates range from 6.3 to 6.65.

6 *Ceti.* 10.20.86, 4.5; 10.21.86, 4.1; 11.18.86, 4.55; 11.26.86, 4.5; 12.25.86, 4.45; 11.9.87, 4.3; 11.3.88, 4.4. Estimates range from 4.1 to 4.55.

45 *Sculptoris.* 12.2.88, 6.5.

8 *Ceti.* 12.2.88, 5.2. Gould, variable? No evidence of change furnished from my observations.

63 *Piscium.* 10.19.87, 4.75; 11.3.88, 4.75; red. Has apparently faded from 4.4 in 1884 to 4.75 in 1888.

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155 *Canis Majoris* = Ch. 2610. Discovered by me to be a variable of the Algol type in 1887, with a probable period of about $1^d\ 3^h \pm$. Dr. Chandler's elements give the following: Epoch of Min. 1887, March $26^d\ 15^h\ 18^m.0 + 1^d\ 3^h\ 15^m\ 46^s$ E. Varies from $5^M.9$ to $6^M.7$. Duration of decrease and increase about $2\frac{1}{2}$ hours each; remains at maximum brightness 22 hours.

12 *Antliæ* = Ch. 3407. Discovered to be variable by Paul in 1888, with a probable period of either $11^h\ 31^m$ or $7^h\ 46^m$. My observations of 1891 confirmed the variability, established the last named period as the true one, and determined the variation to be of the Algol type. Dr. Chandler, from a more rigid determination of elements, gives the following: Epoch of Min. 1888, April $13^d\ 12^h\ 55^m.4 + 0^d\ 7^h\ 46^m\ 48^s.0$ E. Variation from $6^M.7$ to $7^M.3$. The star remains at maximum brightness about $4^h\ 30^m$; the decrease and increase occupying each about $1^h\ 40^m$. This variable has the shortest known period.

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II.

*On a Table of Standard Wave Lengths of the Spectral Lines.**

By HENRY A. ROWLAND.

Presented May 10, 1893.

Some years since, having made a machine for ruling gratings and discovered the concave grating, which placed in my hands an excellent process for photographing spectra, I applied myself to photograph the solar spectrum. The property of the concave grating, mounted in the method which I use, of producing a normal spectrum gave me the means of adding a scale of wave lengths, and so producing a photographic map of the solar spectrum on a very large scale and of great accuracy. I soon after constructed a very much better ruling engine, which is kept at a uniform temperature in the vault of the new physical laboratory of the Johns Hopkins University, with which I have made very much better gratings. I therefore went over the whole process once more, extending the map to include *B*, and making new negatives of the whole spectrum very much better than the old. This set of ten photographic plates is now familiar to most spectroscopists.

In order to place the scale on the negatives, it was necessary to know the wave lengths of certain standard lines. Of course my first thought was of Angström, whose measurements were the wonder of his time. On trying to place my scale according to his figures, I found it impossible to make them and my photographs agree; and I finally was forced to the conclusion that a new series of standards was needed before I could go further. Here again the concave grating came to my rescue. All the spectra are in focus at once, and relative measures can thus be made at once by micrometric measures of the overlapping spectra. Again, the spectrum is normal, and so a micrometer of very long range could be used.

* An abstract of this paper has recently appeared in "Astronomy and Astro-Physics," and in the "London Philosophical Magazine."

Mo. Bot. Garden.
1897.

To obtain the primary standards by means of overlapping spectra, I have used gratings with from 3,000 up to 20,000 lines to the inch, and from 13 to 21½ feet focus. The first series made with the 13-foot grating by Mr. Koyl in 1882 was not found quite accurate enough, and I have since made personally a long series with gratings of 21½ feet focus which is much more accurate. These long focus gratings had from 7,000 to 20,000 lines to the inch, and were ruled on two dividing engines, while the 13-foot one had a less number, possibly 3,000. There are two principal errors to guard against in this method, the first peculiar to the method of coincidences, and the second to any method where gratings are used.* The first is that, where spectra are over each other and the lines therefore often on top of each other, the line of one spectrum may be apparently slightly displaced by the presence of one from another spectrum, although the latter may be almost invisible. The use of proper absorbents obviates this difficulty. The second source of error is more subtle, and arises from the diamond ruling differently on different parts of the grating. It is more apt to occur in concave gratings than plane ones, although few are perfectly free from the error, as it is very difficult to get a diamond to rule a concave grating uniformly. Looking at the grating in spectra of different orders, the grating may appear uniform from end to end in one, and possibly brighter at one end than the other in another spectrum. This gives a chance for any imperfection in the form of the surface of the grating, or any errors in its ruling, or indeed the spherical aberration of the lenses or concave grating, to affect the measurement of relative wave length.† This error I have guarded against by using only uniformly ruled gratings, reversing them, and using a great number of them. I have also used the coincidence of only the lower orders of spectra, such as the 2d, 3d, 4th, 5th, and 6th. Coincidences up to the 12th were, however, observed by Mr. Koyl with the 13-foot concave, and probably have some errors of this nature.

In this way I established about fifteen points in the visible spectrum which served as primary standards. These were so interwoven by the coincidences that I have great confidence in the value of most of them. Indeed, no process of angular measurement could approach the accuracy of this one.

* The variation of the dispersion of the air with the thermometer and barometer is probably not worth considering for the visible part of the spectrum, although it might be worth investigating for the two extremities of the spectrum.

† The error of using gratings of variable brightness in different parts, or those with imperfect ruling of any kind, I have constantly guarded against. Such I believe to be the principal causes of the great errors in relative and absolute wave lengths in Vogel's tables, as the gratings he used, made by Wandschaft, were full of errors of all kinds.

Thus, using a line P to start with, I determine other groups of lines, a', b', c', d', etc. From these again I find groups, some of which may be the same as the first; then again from these, other groups. The process can be continued further, but we are apt to come back to the same lines again, and we are further limited by the visibility of the lines. Thus the limit of great accuracy by eye observation in either direction is practically 4200 and 7000; although in a dark room, especially in the first spectrum, one can see much further, even beyond the A group, although it is difficult to set on the lines, and one is apt to mistake groups of lines for single lines.* When one uses a group as a standard, and one or more of the group is an atmospheric line which varies, the measures will of course vary also, unless the atmospheric line is in the centre of the group. This is a very common source of error, and has caused me much trouble. In a grating with a very bright second spectrum, I have, however, obtained the coincidence of A with the region whose wave length is about 5080, and have thus confirmed the value given in my preliminary table, which was obtained by a very long interpolation passing from the first into the second spectrum.

The accuracy of these primary standards can be estimated from the equations given in Table VII. It is there seen that there is scarcely any difference in the different measures as derived from different lines.

It is to be specially noted that the wave length of P and the lines directly determined from it have no more weight than any of the others. The table might just as well have been arranged with the D line, or any other, first. The true way of discussing the results is to form a series of linear equations, about twenty-six in all, and solve them. This is the method I have used, although I have not discussed them by the method of least squares.†

Some miscellaneous observations not included in the table allowed me to add a few more lines to these primary standards.

Having completed these primary standards, I then observed several hundred standard lines in the visible spectrum, including these primary standards, with a micrometer having a range of five inches, and very accurately made. The spectrum being strictly normal, the readings so made were proportional to the wave length. They could have been used simply to interpolate between the primary standards, but I preferred another method: The readings of the micrometer were

* In a very bright grating I have faintly seen, and even measured, lines down to wave length 8500. My assistant, Mr. L. E. Jewell, can see far into what is called the ultra violet, even to wave length 3500 or beyond.

† The calculations of this paper have involved about a million figures, of which I have personally written more than half. Hence I am not anxious for more labor of this kind.

made to overlap, so that, by adding a constant to each set, a continuous series could be formed for the whole spectrum which would be proportional to the wave length except for some slight errors due to the working of the apparatus for keeping the focus constant. Making this series coincide with two standards at the ends, the wave lengths of all could be obtained by simply multiplying the whole series by one number and adding a constant. This usually gave the wave lengths of the whole spectrum within 0.1 or 0.2 divisions of Angström. The differences of this series from the primary standards were then plotted, and a smooth curve drawn through the points thus found. The ordinates of this curve then gave the correction to be applied at any point.

It is to be noted that the departure from the normal spectrum was very small, and the correction thus found was very certain. The cause of the departure was not apparent, but may have been the slight tilting of the spectrum, by which it was measured somewhat obliquely at places.

The visible spectrum was thus gone over five or more times in this manner, with several different gratings and in different orders of spectra. The results are given in Table X., Columns *C*, *R*, *p*, *q*, *m*, *O*, *e*, *h*, *i*, etc. The spectrum from the green down to and including *A* was also observed on a large instrument for flat gratings, having lenses six and one half inches in diameter and of eight feet focus. These latter observations are marked *C′*. This region I intend at some future time to observe further.

It was now required to observe the ultra violet to complete the series. For this purpose the coincidences of the 2d, 3d, 4th, 5th, and 6th spectra of a 7000, 21½ feet radius, grating were photographed. My instrument will take in photographic plates twenty inches long, but there will be a slight departure from a normal spectrum in so long a plate. Hence plates ten inches long were mostly used for this special series. Before the camera was placed a revolving plate of metal about three sixteenths of an inch thick, and having a slit in it of the same width.* When the flat side was parallel to the camera plate, a strip of the spectrum three sixteenths of an inch wide fell on the plate. When turned ninety degrees, the plate shielded this portion and exposed the rest. Using absorbents, it was thus possible to photograph a strip of say the 4th spectrum between two strips of the 5th. This arrangement is better than having only two edges come together. To correct any movement of the apparatus during the time of exposure, I expose on one spectrum, then on the other, and back again on the first.

* This is described in the Johns Hopkins Circular of May, 1889, by Dr. Ames.

Placing the negatives so obtained on a dividing engine with a microscope of very low power and a tightly stretched cross hair, the coincidence of the two spectra can be measured. Owing to the large scale of the photographs, — about that of Angström, — an ordinary dividing engine having errors not greater than $\frac{1}{1000}$ inch can be used, but the negatives should be gone over at least twice, reversing them end for end. Two screws were used in the engine and finally another complete machine was constructed, giving wave lengths direct with only a slight correction. For determining the wave length of metallic lines, the same process can be used with wonderful accuracy.

The results are given in the columns marked *Pl.* with the number of the plates. The accuracy is very remarkable, and I think the figures establish the assertion that the coincidence of solar and metallic lines can be determined with a probable error of one part in 500,000 by only one observation.

This process not only gave me measures of the ultra violet, but also new observations of the visible spectrum. So far in my work on these coincidences, I have only used erythrosin plates going a little below *D*; but cyanine plates might be used to *B*, or even in the ultra red, as Trowbridge has recently shown. One plate, No. 20, however, connects wave lengths 6400 and 3200.

Thus I have constructed a table of about one thousand lines, more or less, which are intertwined with each other in an immense number of ways. They have been tested in every way I can think of during eight or nine years, and have stood all the tests; and I think I can present the results to the world with confidence that the results of the relative measures will never be altered very much. I believe that no systematic error in the relative wave lengths of more than about ± .01 exists anywhere except in the red end as we approach *A*. Possibly ± .03, or even less, might cover that region.

The relative measures having thus been obtained, we have means in the concave grating of obtaining the wave lengths of the lines of metals to a degree of accuracy hitherto unknown, and thus of solving the great problem of the mathematical distribution of these lines.

But for the comparison of spectra, as measured by different observers, some absolute scale is needed. Hitherto Angström has been used. But it is now very well known that his standard measure was wrong. As his relative measures are also very wrong, I have concluded that the time has come to change not only the relative measures, but the absolute also. To this end Dr. Louis Bell worked in my laboratory for several years with the best apparatus of modern science, using

two glass and two speculum metal gratings, ruled on two dividing engines with four varieties of spacing, three of which were incommensurable or nearly so, with two spectrometers of entirely different form, with a variety of standard bars compared in this country and in Europe, and with a special comparator made for the measure of gratings. His result agrees very well with the next best determination, that of Mr. C. S. Peirce of the U. S. Coast Survey. His final result agrees within 1 in 50,000 with his preliminary value.* This most recent value, combined with those of Pierce, Müller and Kempf, Kurlbaum and Angström, I have adopted to reduce my final results to, although the calculations are made according to Bell's preliminary value. See Appendix A.

But it rests with scientific men at large to adopt some absolute standard. The absolute standard is, of course, not so important as the relative, and possibly the average of Angström might be adopted. But for myself I do not believe in continuing an error of this sort indefinitely. All the results obtained before the concave grating came into use were so imperfect, that they must be replaced by others very soon. With a good concave grating, one man in a few years could obtain the wave lengths of the elements with far greater accuracy than now known.

As an aid to this work, I have constructed the table of wave lengths given in this paper, which have already been adopted by the British Association and by the most noted writers of Germany and other countries, and sincerely hope that it will aid in the work of making the wave length of a spectrum line a definite quantity within a few hundredths of a division of Angström.

Absolute Wave Length of *D*.

The following is an estimate of the absolute wave length of the *D* line from the best determinations. First, I shall recalculate the portion of Dr. Bell's paper† in which the calibration of the grating space is taken into account. The method of correction is founded on the principle that a linear error in the spaces only affects the focal length, and not the angle, and that small portions which have an error, and thus throw the light far to one side, should be rejected. The corrections Dr. Bell has used seem to me very proper, except to grating III., which appears to me to be twice too great. I find the following:—

* American Journal of Science, 1887.

† American Journal of Science, 1888.

Grating.	*D.*	Correction.	Final Values.
I.	5896.20	–.02	5896.18
II.	5896.14	+.09	5896.23
III.	5896.28	–.06	5896.22
IV.	5896.14	+.03	5896.17

Mean value, 5896.20.

This is very nearly the value given by Dr. Bell.

The determination of Mr. C. S. Peirce of the U. S. Coast Survey is certainly a very accurate one. Dr. Bell and myself have made some attempts to calibrate his gratings, which he sent to us for the purpose, and to correct for the scale used by him. There is great uncertainty in this process, as we had only a portion of the necessary data. The correction of his scale was also uncertain, because the glass scales used by him may have changed since he used them, in the manner thermometer bulbs are known to change. Correcting, then, only for the error of ruling in the gratings, we have:

Peirce's value	5896.27
Correction *	–.07
	5896.20

The correction for the scale would be about as much more in the same direction, provided the glass scales had not changed. But it is too uncertain to be used, although I have applied it in my preliminary paper.

Kurlbaum's result, made with two good modern gratings, has the defect that the gratings were 42 and 43 mm. broad, quantities which it is impossible to compare accurately with a meter. His small objectives, one inch in diameter, could not take in light from the whole grating, and so the grating space was not determined from the portion of the grating used. The spectrometer was poor, and the errors of the grating undetermined.

Müller and Kempf used four gratings, evidently of very poor quality, as they give results which differ 1 in 10,000.

The result of Angström was a marvel at the time, but the Nobert gratings used by him would now be considered very poor. Taking Thalen's correction for error of scale, we have for the mean of the E lines 5269.80, which gives, by my table of relative wave lengths, $D = 5895.81$. It is rather disagreeable to estimate the relative accuracy of observations made by different observers and in different countries, but in the interest of scientific progress I have attempted it, as follows:—

* Bell, American Journal of Science, May, 1888, p. 365.

		Wt.
Angström	5895.81	1
Müller and Kempf .	5896.25	2
Kurlbaum	5895.90	2
Peirce	5896.20	5
Bell	5896.20	10

Mean, 5896.156 in air at 20° and 760 mm. pressure.

This must be very nearly right, and I believe the wave length to be as well determined as the length of most standard bars. Indeed, further discussion of the question would involve a very elaborate discussion of standard meters, a question involving endless dispute. I think we may say that the above result is within 1 in 100,000 of the correct value, which is very nearly the limit of accuracy of linear measurements. This should be so, as the probable error of the angular measures affects the wave length only to 1 in 2,000,000,* and hence nearly the whole accuracy rests on the linear measures.

Résumé of Process for obtaining Relative Wave Lengths.

1. Determination of about 20 lines in the visible spectrum by coincidences by Koyl.†

2. Determination of about 15 lines in the visible spectrum by coincidences by Rowland, using several gratings of $21\frac{1}{2}$ feet focus.

3. Interpolation by direct eye observations with concave gratings of $21\frac{1}{2}$ feet focus and micrometer of 5 inches range and of almost perfect accuracy.

4. Interpolation by means of flat gratings.

5. Measurement of photographic plates from 10 to 19 inches long, having two or three portions of the spectrum in different orders on them, thus connecting the ultra violet and blue with the visible spectrum. The fact that nearly the same values are obtained for the violet and ultra violet by use of different parts of the visible spectrum proves the accuracy of the latter.

6. Measurement of photographic plates having the solar visible spectrum in coincidence with the metal lines of different orders of spectra. The fact that the

* Is not a grating and spectrometer thus the best standard of length, and almost independent of the temperature? Gratings of 10 cm. length can now be ruled on my new engine with almost perfect accuracy, as seen in the calibration of Grating IV. in Dr. Bell's paper, and it seems to me the time has come for their practical use.

† These observations of Mr. Koyl were finally given no weight, on account of the inferior apparatus used. They serve a useful purpose, however, as checks on the other work.

wave lengths of the metal lines are very nearly the same as obtained from any portion of the visible or ultra violet spectrum proves the accuracy of the latter, as well as that of the metallic wave lengths.

7. Measurement of plates having metallic spectra of different orders.

Advantages of the Process.

The only other process of obtaining relative wave lengths is by means of angular measures. Supposing the angle to be about 45°, an error of 1″ will make an error of about 1 in 200,000 in the sine of the angle. When one considers the changes of temperature and barometer measuring on one line and then another, together with the errors of graduation, it would be a difficult matter to measure this angle to 2″, making an error of 1 in 100,000, or about $\frac{1}{20}$ division of Angström.

Looking over the observations of principal standards made under the direction of Professor Vogel in Potsdam, with very poor gratings but an excellent spectrometer, we find the average probable error to be about $\pm\frac{1}{150000}$ of the wave length, which is not far from the other estimate. This does not include *constant* errors, and I believe the probable error to be really greater than this.

The method of coincidences by the concave grating gives far superior results. The distance to be measured is very small, and the equivalent focal length of a telescope to correspond would be very great (21½ feet). Furthermore, all changes of barometer and thermometer are eliminated at once, except the small effect on the dispersion of the air, which, when known, can be corrected for. It is not to be wondered at that this method is far superior to the former. The probable error is, indeed, reduced to $\pm\frac{1}{1000000}$, or even less for the best lines. Where the interpolation can be made on photographs, this probable error is scarcely increased at all; but even taking it at twice the above estimate, the method even then remains from three to five times as accurate as that of angular measurement. Indeed, the impression made on my mind in looking over Vogel's Potsdam observations is, that my tables and process are ten times as accurate as theirs; and I think any careful student of both processes will come to a similar conclusion.

The wonderful result that can be obtained by the measurement of photographs on the new micrometer, which can measure plates over twenty inches long, is partly seen in the table. Where the distance is only a few inches, the wave length of a series of lines can be measured with a probable error of less than $\frac{1}{15}$ of a division of Angström. Indeed, a series would determine any line so that the probable error

would be even ±.0000001 of the whole. This would detect a motion in the line of sight of ±140 feet per second!

From the tests I have made on my standards, I am led to believe that down to wave length 7000, a correction not exceeding ±.01 division of Angström (1 part in 500,000), properly distributed, would reduce every part to perfect relative accuracy.

To ascend to the next degree of accuracy would need many small corrections which would scarcely pay. It is reasonable to assume that a higher degree of accuracy will not be needed for twenty-five years, as the present degree is sufficient to distinguish the lines of the different elements from one another in all cases that I have yet tried.

Details of Work.

To reduce all the observations in a given region to one line, relative observations extending a short distance either side of the standard region are necessary. Thus the mean of 4215 and 4222 can be taken as the standard, and, if only one is observed, it can be reduced to the standard by a correction +3.358 or −3.358. But it is not necessary to take the mean of the lines as a standard, as any one of them may be so taken, or even any other point where there is no line, as the point is only to be used in the mathematical work, and finally disappears altogether.

Table II. gives results of this nature. The letters at the top of each series, *e, g, h, j*, etc., are the arbitrary names of the standards. The first columns refer to the series of observations, "Co." being observations made at the time of measuring the coincidences; Plate 9, 10, etc., refer to photographic plates; *C, R*, etc., refer to the series as given in the final table, although they may differ very slightly from the latter, as the final table contains slight corrections. Figures in parentheses are the number of readings. The photographs were usually measured from two to six times.

Table III. gives the first series of observations made in 1884 with a 21½ foot concave, 14,436 lines to the inch. The numbers taken for the standards are only preliminary, and agree as nearly as practicable with my Table of Preliminary Standards. As only *differences* are finally used, they are sufficiently near. The fractions give the order of the spectra observed.

Thus, the first observation on *h* and *t* is worked up as follows:—

	4691.590	7027.778
Correction to standard	−.626	+2.785
	4690.964	7030.563

4691.590	4690.326	7027.778
−.626	+.626	+2.785
4690.964	4690.952	7030.563

4691.590	7040.092
−.626	−9.547
4690.964	7030.545

Weight.	*h*.	*t*.
1	4690.964	7030.563
2	4690.958	7030.563
2	4690.964	7030.545
	4690.962	7030.556

The equation $3h - 2t = 11.774$ then readily follows.

Tables IV. and V. are from a 21½ foot concave with 7218 lines to the inch, used on both sides, and thus equivalent to two gratings used on one side only. I have not yet determined theoretically whether the minor errors are perfectly neutralized in this manner; but it would evidently have a tendency in this direction.

The photographic coincidences are given in the main table (X.), as not only the standards are compared by this process, but whole regions are photographed side by side. Both a 10,000 and a 20,000 concave were used for this work.

Table VI. gives the collection of the equations relating to the visible spectrum, the final results being given in Table VII.

The proper method of treating these twenty-six equations would be by the method of least squares. But it would be so long and tedious, and so liable to mistake, that I have adopted the method of starting at one point, and going forward until all the equations are reached. Thus (Table VII.), starting with an assumed value of *e*, we can calculate *p*, *n*, *l*, *k*, *j*, *o*, *t*.

Using the eight values thus found once more, from *p* we have *g*, *k*, *l*; from *n* we have *h*, *t*, *g*; with similar results for the others. Collecting, we then have *e*, *f*, *g*, *h*, *j*, *k*, *l*, *n*, *o*, *p*, *q*, *t*. Using these once more, we have values of all the standards. We could do this any number of times, keeping the proper weights; but I thought this number was sufficient. The second calculation is done in the same manner, starting from *o*, however, and is given in Table VIII.

The results of the two calculations are give in Table IX. Taking the mean and adding the results of local micrometer measurement, we obtain the column marked "Relative Wave Lengths."

Reducing these values by 1 part in 200,000, we make them agree with the absolute value of the standard as before agreed upon. Thus the column of standards is obtained for use in the visible spectrum.

For ordinary interpolation with the short and imperfect micrometers generally used, and working with a flat grating and a spectrum not normal, the standards would be too far apart. But with such a long and perfect micrometer as I use, and working with the normal spectrum of a concave grating, they are entirely sufficient. However, I have filled in the interval from 7030 to 7621 by some extra sub-standards at 7230.

The micrometer for eye observations has a range of five inches, and the machine for measuring photographs of more than twenty inches, both with practically perfect screws made by my process. The eye observations are not an interpolation, in the ordinary sense, between the standards, but the whole series is continuous, the micrometer observations overlapping so that they join together to any length desired. By measuring from the *D* line in one spectrum to the *D* line in the next, and including the overlapping spectra, no further standards would be necessary, as all the lines of the spectrum would be determined at once, knowing the wave length of the *D* line. But I usually plotted the difference of the standards from the micrometer determination, usually amounting to less than one or two tenths of a division of Angström, and so corrected the whole series to the standards. Sometimes two, or even three, overlapping spectra were measured at once.

To make Table X., the following process was used.

1st. From all the observations at my disposal, I determined a few more lines around the main standards, and put them in the second column, marked St., so that I should have a greater number of points to draw my curve through.

2d. I then put down a few observations which were made by measuring overlapping spectra.

3d. Then the main eye observations were put down as follows: —

p	extending	from	4071 to 7040,	2d spectrum, 14,436 grating.
q	"	"	4999 to 7035,	" " " "
O	"	"	4859 to 7040,	" " " "
c	"	"	4859 to 6079	(fragmentary).
C	"	"	6855 to 6909,	2d spectrum, 14,436 grating.
R	"	"	5162 to 7201,	" " " "
h	"	"	5742 to 7628,	1st spectrum, 14,436 grating.
i	"	"	6065 to 7671,	" " " "
C′	"	"	6855 to 7714,	plane grating.
R′	"	"	5139 to 5296,	2d spectrum, 14,436 grating.
t	"	"	6499 to 6929,	" " " "
a	"	"	6278 to 6322,	" " " "
E	"	"	4048 to 4824,	" " " "

4th. The series of photographs containing coincident spectra, mostly on plates so short as to make the spectra nearly normal, were now introduceed. The plates were numbered from 1 to 20, Nos. 7 and 19 being rejected because imperfect.

This series of plates were obtained by photographing a narrow strip of one spectrum between two strips of another, the overlapping spectra being separated by absorption. In order to eliminate any change in the apparatus during the exposure, the latter was divided into three parts, the first and third being given to the same spectrum.

This series of plates gives me a continuous series of photographs from wave length 7200 to the extremity of the ultra violet spectrum, each part being interwoven with one or two other parts of the spectrum. Thus, wave length 3900 comes from 5200 and 5850 with only a slight difference in values. There is scarcely any difference in any wave length as derived from any portion of the spectrum; thus proving the accuracy of the whole table. The description of the plates is as follows.

PHOTOGRAPHIC COINCIDENCES.

Concave Grating 10,000 Lines to the Inch.

Spectra.	Plate.				Standard.
3/4	1	4407 to 4643	and	3331 to 3486	*f, g*
"	2	4637 " 4890	"	3478 " 3667	*h, j*
"	3	4823 " 5068	"	3612 " 3805	*j, k*
"	4	4919 " 5133	"	3683 " 3875	*j, k*
"	5	5050 " 5288	"	3780 " 4005	*k, l*
"	6	5097 " 5333	"	3821 " 4157	*k, l*
"	7				
"	8	5242 " 5477	"	3937 " 4121	*l, m*
"	9	5405 " 5662	"	4073 " 4222	*m, n, e*
"	10	5582 " 5816	"	4293 " 4376	*n, f*
"	11	5782 " 5934	"	4343 " 4447	*o, f*
"	12	4157 " 4267	"	3129 " 3218	*e*
"	13	4157 " 4325	"	3094 " 3246	*e*
"	14			3218 " 3318	
"	15	4391 " 4643	"	3292 " 3478	*f, g*
4/6	16	5788 " 5977	"	3864 " 3977	*o*
"	17	5788 " 5977	"	3864 " 3984	*o*
"	18	5715 " 5977	"	3875 " 3977	*o*
"	19				
1/2	20	5853 " 6569	"	3024 " 3267	*o, p, q*

Plates 7, 14, and 19 were imperfect, owing to clouds passing over the sun, although a part (3218 to 3318) of Plate 14 was used for interpolation, as observations were scanty in that region.

It is seen that some of the plates have only one standard upon them. With a plane grating it would be impossible to work them up, but with the normal spectrum produced by the concave grating only one is necessary, as the multiplier to reduce readings to wave lengths is nearly a constant. In working up a whole series of plates, there is no trouble in giving a proper value to the constant for any plate in the series which has only one standard.

Plate 17 was measured twice by two dividing engines, and as it was a specially good plate, each measure was given a weight equal to one of the other plates. The principal error to be feared in these plates is a displacement of the instrument between the time of the exposure on the two spectra. This was guarded against by the method above described. In Plates 17 and 20 there was a portion of the plate on which both the spectra fell all the time, and thus gave a test of the displacement. This was found to be zero. The other plates overlap so much that there are generally two or more determinations of each line. A comparison of these values shows little or any systematic variation in the different plates exceeding $\frac{1}{100}$ division of Angström. Plates 16, 17, 18, and 5, 6, 8, all give the region 3900 as derived from 5200 and 5850, and thus give a test of the relative accuracy of these latter regions. It is seen that the two results of the region 3900 differ by about .015 division of Angström. Were the wave lengths of the region 5170 to 5270 to be increased by .020 the discrepancy would cease. The amount of this quantity seems rather large to be accounted for by any displacement of the spectra on the plates, but still this may be the cause. Again, it is possible that different gratings may give this difference of wave length from the cause I have mentioned above. This cause, as I have shown, exists in the same degree in plane gratings as in concave. I have not attempted to correct it in this case, but have simply taken the mean of the two values for the region 3900, and so distributed the error. This is the greatest discrepancy I have found in the results, except in the extreme red.

Thus the region 3100 to 3200, a portion for which Plate 20 is to be relied upon, gives the wave length of the ultra violet .01 division of Angström higher from the region 4200 than from 6300. As the discrepancies in this region before the invention of the concave grating were often a whole division of Angström, I have regarded this result as satisfactory. Indeed, until we are able to make all sorts of corrections due to the change in the index of refraction of the air with the barometer and thermometer, it seems to me useless to attempt further accuracy.

With the advent of photographic plates into the table, especially the longer ones required for metallic spectra, it becomes necessary to correct them for the departure

from the normal spectrum due to the use of long plates. The plates in the box are bent to the arc of a circle of radius r. When afterwards straightened we measure the distance by a linear dividing engine. Hence, what we measure is the arc with radius r. Let α and β be the angles of incidence and diffraction from the grating. We have then to express β in terms of δ. Let λ be the wave length, and n and N the number of lines on the grating to 1 mm. and the order of the spectrum respectively. Then

$$\lambda = \frac{1}{nN}(\sin\alpha + \sin\beta)\,;$$

$$\sin\beta = \frac{2r}{R}\sin\frac{\delta}{2}\cos\left(\gamma + \beta - \frac{\delta}{2}\right).$$

In these formulæ α is the angle to the centre of the photographic plate, and β and δ are also measured from the centre. γ is the angle between the radius from the centre of the photographic plate and the line drawn from that point to the centre of the grating. When properly adjusted, γ will be zero. Also we make $2r = R$, to obtain perfect focus throughout. So that

$$\lambda = \frac{1}{nN}\left(\sin\alpha + \sin\frac{\delta}{2}\right).$$

Calling λ_0 the wave length at the centre of the plate, we have approximately

$$\lambda - \lambda_0 = \frac{\delta}{2nN} - \frac{n^2N^2}{6}(\lambda - \lambda_0)^3 + \text{etc.}$$

The first quantity, $\frac{\delta}{2nN}$, is the value of $\lambda - \lambda_0$, assuming the spectrum to be normal. The last term is the required correction expressed in terms of the provisional wave length. The correction in actual practice has been made from a plot of the correction on a large scale, and never amounted to more than a few hundredths of a division of Angström, even for the longest plate.

In two or three plates the camera was displaced, so that γ had a value. In such cases no attempt was made to measure γ, but the plates were only used for local interpolation by drawing a curve through certain points used as substandards.

These substandards were principally used for working up the last set of photographic plates containing the solar spectrum and the metal spectra of the same or higher orders, or both. Some of them contained three metallic spectra.

Thus the region 3900 in the solar spectrum has been obtained from both wave lengths 5200 and 5850. The mean of these gave values of the substandards for working up the plates taken at this point, and containing also metallic lines at 2700.

Again, the boron lines at 2496 and 2497 have been obtained from the regions 4800, 3200, and 3600. The mean values give substandards for working up the metallic spectra of that region. Also the near coincidence in the values of the wave lengths of these lines indicate the relative accuracy of the regions 2496, 3200. 3600, and 4800.

The use of these substandards is as follows. The photographic plates, mostly 19' inches long, were measured mostly on a machine giving wave lengths direct. The difference of the results from the substandards were then plotted on a paper having the curve of correction for length upon it in such a way that the final marks should theoretically be a straight line. This was actually the case in all but a few plates, in which the camera was displaced. A straight line was then passed through all the marks as nearly as may be, and the correction taken off. This correction could thus be obtained to $\frac{1}{1000}$ division of Angström, and amounted to only a few hundredths of a division at most. Possibly $\frac{1}{10}$ division of Angström was the greatest correction required for length.

In this way each plate represents the average of all the wave length determinations throughout its extent, and will not admit of any correction save a linear one, should such ever be required in working over the table again.

In every plate having a solar and metallic spectrum upon it, there is often—indeed always—a slight displacement. This is due either to some slight displacement of the apparatus in changing from one spectrum to the other, or to the fact that the solar and the electric light pass through the slit and fall on the grating differently. In all cases an attempt was made to eliminate it by exposing on the solar spectrum, both before and after the arc, but there still remained a displacement of $\frac{1}{100}$ to $\frac{2}{100}$ division of Angström, which was determined and corrected for by measuring the difference between the metallic and coinciding solar lines, selecting a great number of them, if possible.

The changes from sun to arc light are much more extensive than from one order of solar spectrum to another. In two cases I have tested the latter, and found no displacement, and have no fear that it exists in the others.

In working up the plates, I have started at the plates whose centre is at wave length 4600, and proceeded either way from that point. For this purpose I have

used the plates originally obtained for metallic spectra, generally using the lines due to the impurities. The method, I believe, is obvious from the table. For a long region no substandards are necessary, but are used whenever they become so.

TABLE I.

PRELIMINARY OBSERVATIONS BY MR. KOYLE,

MADE AT BALTIMORE IN 1882 AND 1883.

Wt.	Spectra.	From 5624.23 and 5624.76.	From 4824.34.	*From Table.
2	$\frac{6}{8}$	4215.67		.67
1	$\frac{10}{13}$	4325.92		.94
1	$\frac{7}{9}$	4376.06		.10
1	$\frac{8}{10}$ {	4497.06		.05
1		4501.44		.44
1	$\frac{10}{12}$	4691.64		.58
4	$\frac{6}{7}$	4824.34		.33
3	$\frac{7}{8}$ {	4919.15		.18
2		4920.70		.68
2		4924.13		.11
1	$\frac{8}{9}$ {	4994.39		.32
3		5006.31		.30
3	$\frac{9}{10}$	5060.22		.25
1		5109.82		.82
2	$\frac{10}{11}$	5110.58		.57
1		5162.51		.45
1	$\frac{9}{10}$ {		5353.64	.59
1			5361.83	.81

Wt.	Spectra.	From 5624.23 and 5624.76.	From 4824.34.	From 6563.04.	From 5162.51.	From Table.
1		5624.23				.25
1		5624.76				.77
1	$\frac{5}{6}$ {			5788.11		.14
				5791.21		.21
2	$\frac{9}{10}$ {			5890.19		.18
				5893.07		.10
2	$\frac{9}{10}$			5896.17		.15
4	$\frac{9}{10}$			5914.36		.38
2	$\frac{8}{10}$ {		6024.31			.28
			6027.31			.27
1	$\frac{9}{10}$	6246.58				.58
3	$\frac{8}{9}$	6322.91				.91
6	$\frac{7}{8}$	6431.09				.06
3	$\frac{6}{7}$	6563.04				.05
2	$\frac{5}{6}$	6750.41				.41
1	$\frac{5}{6}$	6752.92				.96
1					6884.11	.08

* This column has been added from the final table of standards, because no use was made of Mr. Koyle's observations on account of the inferior grating he used. The comparison is thus of special interest. The differences are probably due to want of precautions which were finally adopted.

TABLE II.

RELATIVE MEASURES AROUND STANDARDS.

[*The figures in parentheses are the number of readings.*]

e.

	4215	4222
Co. (8)	0	6.720
" (8)	0	6.714
" Phot.	0	6.723
" (8)	0	6.717
" (8)	0	6.710
" (4)	0	6.715
Mean	0	6.7166
Plate 9	0	6.724
" 10	0	6.724
" 12	0	6.705
" 13	0	6.707
" 19	0	6.725
Mean	0	6.717
Correction to standard .	+3.358	−3.358

g.

		4494	4497	4501	4508
Co. (4)	Wt. 1	−2.308	0	4.398	11.415
" (6)	" 1	−2.313	0	4.397	11.412
" (6)	" 1	−2.317	0	4.400	11.409
" (4)	" 1	−2.332	0	4.401	11.418
	Mean	−2.317	0	4.399	11.413
Plate 15		−2.321	0		
" 1		−2.328	0	4.392	11.410
	Mean	−2.324	0	4.392	11.410
Give first three times weight of second mean		−2.319	0	4.397	11.412
Correction to mean . . .		5.270	5.270	5.270	5.270
Correction to standard .		+7.589	+5.270	+0.873	−6.142

h.

	4690	4691	
Co. (8)	0	1.257	
" (6)	0	1.245	
" (4)	0	1.249	
" (2)	0	1.254	
" (6)	0	1.251	
Mean	0	1.251	
Plate 2	0	1.254	3.925
Correction to standard .	+ 0.626	−.626	

j.

	4903	4924	4924
Co. (4)	0	20.638	21.474
" (4)	0	20.632	21.476
Plate (3)	0	20.609	21.466
Mean	0	20.626	21.472
Correction to standard .	+14.033	−6.593	−7.439

k.

	5060	5064	5068
Co. (8)	0	4.585	8.686
Plate 3	0	4.586	8.698
" 4	0	4.588	8.706
" 5	0	4.578	8.695
Mean	0	4.584	8.696
Correction to standard .	+4.427	−0.157	−4.269

l.

	5269
Co. (6) . . .	.783
" (4) . . .	.781
" (6) . . .	.788
" Phot. .	.780
Mean	.783

	5270
C	.756
R	.773
p	.757
m	.780
d	.768
c	.782
C	.780
S	.780
R'	.774
Plate 9	.786
" 5	.781
" 6	.792
" 7	.798
" 8	.777
Mean	.779

	.783
	.777
Mean	2) .780
Correction to standard	±.390

n.

Co. Weight	2	.500
" "	2	.515
" "	1	.516
" "	2	.512
" "	1	.500
" "	1	.517
" "	1	.500
" "	1	.523
Mean		.510

50 observations in all.

	5624	5624
Correction to standard	+.255	−.255

o.

	5862	5890	5896	5914
Co. (4)		0	5.966	24.198
" (4)		0	5.973	24.192
" (6)		0	5.961	24.199
" Phot.		0	5.975	24.203
Mean		0	5.969	24.198
C	−27.593	0	5.981	24.192
R	−27.599	0	5.976	24.222
p	−27.622	0	5.971	24.186
h	−27.605	0	5.954	24.204
Plate 19	−27.582	0	5.990	24.222
" 11	−27.600	0	5.979	24.201
" 16	−27.607	0	5.974	24.200
" 17	−27.612	0	5.976	24.207
Mean	−27.602	0	5.975	24.204
Taking this series with twice the weight of the other, we have	−27.602	0	5.973	24.202
Add	.643	.643	.643	.643
Correction to standard	−28.245	.643	−5.330	−23.559

p.

	6246	6318	6322
Co. (4)	−71.703	0	4.674
" (8)		0	4.674
C	−71.719	0	4.665
R	−71.711	0	4.672
p	−71.704	0	4.667
h		0	4.688
o	−71.718	0	4.660
Mean	−71.711	0	4.671
	2.336	2.336	2.336
Correction to standard	+74.047	+2.336	−2.335

q.

	6563	6564	6569
Co.	0		6.405
C	0	1.323	6.423
R	0	1.331	6.422
p	0		6.415
h	0	1.354	6.400
o	0	1.373	
b	0		6.405
Mean	0	1.345	6.412
Correction to standard	+3.206	+1.861	−3.206

t.

	7023	7027	7040
Co. (2)	0	3.982	16.294
" (4)	0	3.982	16.292
" (6)	0	3.995	16.330
" (4)	0	3.971	16.290
Mean	0	3.984	16.306
C	0	3.998	16.332
R	0	3.980	16.316
h	0	3.939	16.300
C′	0	3.961	16.301
Mean	0	3.970	16.312
General mean	0	3.977	16.309
	6.762	6.762	6.762
Correction to standard	+6.762	+2.785	−9.547

TABLE III.

SIX-INCH CONCAVE GRATING.

Grating 14,436 lines to the inch, and $21\frac{1}{2}$ feet radius.

Observations made in 1884 by Rowland.

Orders of Spectrum.		No. of readings.				
(1)		2 ob.	4691.590		7027.778	
	$\frac{2}{3}$	2 ob.	4691.590	4690.326	7027.778	7040.092
		4 ob.	4691.590			
			$\therefore\ h = 4690.962$		$t = 7030.556$	
		Hence	$3h - 2t = 11.774$			
(2)	$\frac{2}{3}$	4 ob.		4215.656	6322.906	
		Hence	$3e - 2p = 15.900$			
(3)	$\frac{2}{3}$	10 ob.		4376.101	6563.042	
		Hence	$2q - 3f = 4.193$			
(4)	$\frac{2}{3}$	10 ob.	4376.104	6563.042	6564.423	
		Hence	$2q - 3f = 4.220$			
(5)	$\frac{2}{3}$	4 ob.	6884.082	4590.109	4588.364	
(6)	$\frac{2}{3}$	10 ob.		6322.879	4215.655	
		Hence	$3e - 2p = 15.951$			
(7)	$\frac{2}{3}$	7 ob.		6322.879	4215.651	
		Hence	$3e - 2p = 15.939$			

(8) $\frac{2}{3}$ 4 ob. 4501.442 6750.391

Hence $3g - 2s = 6.163$

(9) $\frac{2}{3}$ 8 ob. 4508.445 4504.991 4502.385 4501.442 6750.405

Hence $3g - 2s = 6.117$

(10) $\frac{2}{3}$ 10 ob. 4501.439 6750.403

Hence $3g - 2s = 6.130$

(11) $\frac{2}{3}$ 4 ob.

4222.366 4215.670 6322.902 6318.250 6285.340 6252.782 6246.535

Hence $3e - 2p = 15.898$

(12) $\frac{2}{3}$ 4 ob. 4691.588 7027.782

Hence $3h - 2t = 11.752$

(13) $\frac{2}{3}$ 9 ob. 6439.310 4293.240 (G)

(14) $\frac{2}{3}$ 6 ob. 4691.588 7035.164 7027.771 7016.749 7016.364

Hence $3h - 2t = 11.774$

(15) $\frac{2}{3}$ 6 ob. 4501.426 6750.406

Hence $3g - 2s = 6.085$

(16) $\frac{2}{3}$ 6 ob. 6439.300 6431.070 4293.232

(17) $\frac{2}{3}$ 4 ob. 4823.699 4824.312 7233.927 7233.166 7240.972

Collecting, we have for the relations established by this grating the following equations: —

8 ob.	$3h - 2t = 11.774$	4 ob.	$3e - 2p = 15.900$
4 ob.	$3h - 2t = 11.752$	10 ob.	$3e - 2p = 15.951$
6 ob.	$3h - 2t = 11.774$	7 ob.	$3e - 2p = 15.939$
		4 ob.	$3e - 2p = 15.898$
Mean	$3h - 2t = 11.769$		$3e - 2p = 15.931$

10 ob.	$2q - 3f = 4.193$	4 ob.	$3g - 2s = 6.163$
10 ob.	$2q - 3f = 4.220$	8 ob.	$3g - 2s = 6.117$
		10 ob.	$3g - 2s = 6.130$
		6 ob.	$3g - 2s = 6.085$
Mean	$2q - 3f = 4.207$		$3g - 2s = 6.121$

4 ob.	6884.082	4590.109	4588.364
	28	17	17
	.110	.126	.381

9 ob.	6439.310	4293.240			
	7	5			
	.317	.245			
6 ob.	6439.300	6431.072	4293.232		
	20	20	13		
	.320	.092	.245		
4 ob.	4823.699	4824.312	7233.927	7233.166	7240.972
	685	312	10	10	10
	.014	.000	.917	.156	.962

TABLE IV.

SIX-INCH CONCAVE GRATING, 21½ FEET RADIUS.

7,218 lines to inch. — November, 1884.

Series I. — Grating used Direct.

Observed by Rowland.

(1) $\frac{5}{6}$ 8 ob. 4691.584 4690.328 5624.777 5624.265

Hence $6h - 5n = 23.137$

(2) $\frac{4}{5}$ 6 ob. 4508.455 4501.440 5624.763 5624.248 4497.043 4494.730

Hence $5g - 4n = 13.550$

(3) $\frac{3}{4}$ 8 ob. 4222.382 5624.765 5624.260 4215.661

Hence $4e - 3n = 2.552$

(4) $\frac{3}{4}$ 8 ob. 4222.380 5624.765 5624.268 4215.665

Hence $4e - 3n = 2.538$

(5) $\frac{3}{4}$ 4 ob. 6013.770 4508.473 6003.264 4501.444 4497.050 4494.718

Hence $3\,(6003) - 4g = 16.275$

(6) 4/5/6 8 ob.

4508.449 5405.977 4501.440 6750.394 5397.338 4497.040 4494.723

Hence $6g - 5m = 5.581$; $5m - 4s = 6.709$; $6g - 4s = 12.290$

(7) $\frac{5}{6}$ 8 ob. 6322.910 5270.499

Hence $5p - 6l = -17.779$

(8) $\frac{5}{6}$ 8 ob. 6322.910 5270.499

Hence $5p - 6l = -17.779$

(9) $\frac{5}{6}$ 4 ob. 6322.910 5270.501

Hence $5p - 6l = -17.791$

(10) $\substack{5\\6\\7}$ 4 ob. 5270.500 6322.911 4508.458 4501.454

Hence $5p - 6l = -17.780$; $5p - 7g = 86.633$; $6l - 7g = 104.413$

(11) $\substack{3\\4\\5}$ 6 ob.

The fifth spectrum was very difficult to see, and hence the observations on e are poor.

7040.052 4222.390 7027.717 5270.500 5269.718 4215.681 7023.722

Hence $3t - 4l = 11.055$; $5e - 4l = 14.739$; $5e - 3t = 3.684$

(12) $\substack{4\\5\\6}$ 4 ob. 7040.072 4691.592 5624.765 7027.750 7023.782 5624.267

Hence $4t - 5n = -.440$; $5n - 6h = -23.216$; $4t - 6h = -23.656$

(13) $\frac{4}{5}$ 4 ob. Poor series.

5896.166 4691.585 5862.590

Hence $4o - 5h = 108.549$

(14) $\substack{3\\4\\5}$ 2 ob. Difficult to see.

7040.061 4222.378 5270.499 5269.724 4215.710 7027.749 7023.767

Hence $3t - 4l = 11.134$; $5e - 4l = 14.776$; $3t - 5e = -3.642$

(15) $\frac{5}{6}$ 6 ob. 4691.600 5624.789 5624.277 4686.422 4679.048

Hence $6h - 5n = 23.179$

(16) $\frac{4}{5}$ 4 ob. 7040.067 7035.194 5624.765 7027.757

Hence $4t - 5n = -.426$

(17) $\substack{4\\5\\6}$ 8 ob.

5068.936 6335.556 4222.377 5064.835 5060.250 4215.660 6322.912 6318.238

Hence $4p - 5k = -41.070$; $5k - 6e = 9.262$; $4p - 6e = 31.808$

(18) $\frac{4}{6}$ 15 ob. 4215.650 6322.903

Hence $6e - 4p = 31.776$

(19) $\frac{4}{5}$ 6 ob. 6564.418 6563.046 5270.501 5269.718

Hence $4q - 5l = -85.486$

(20) $\substack{5\\6\\7}$ 4 ob. 5914.366 4222.354 4924.938 4924.098 4215.652 5896.150

Hence $5o - 6j = -50.947$; $6j - 7e = -28.009$; $5o - 7e = 78.956$

(21) $\substack{5\\6\\7}$ 4 ob. 5914.376 4222.370 4924.952 4924.106 4215.652 5896.126

Hence $5o - 6j = -51.043$; $6j - 7e = -27.999$; $5o - 7e = 79.042$

(22) $\frac{5}{6}$ 6 ob. 5788.142 5791.202 4824.320 4823.696

TABLE V.

7,000 GRATING REVERSED

(23) $\frac{4}{5}$ 6 ob. Nov. 15, 1884. Excellent set.

5896.158 5890.189 4703.164 4691.569 4690.324 4683.746

Hence $4\,o - 5\,h = 108.585$

(24) $\frac{4}{5}$ 4 ob. Excellent set.

4508.461 4501.444 5624.770 5624.254 4497.043 4494.711

Hence $5\,g - 4\,n = 13.512$

(25) $\frac{4}{5}$ 4 ob. 4222.369 5270.506 5269.725 4215.670

Hence $5\,e - 4\,l = 14.635$

(26) $\begin{smallmatrix}5\\6\\7\end{smallmatrix}$ 4 ob.

5914.380 4222.382 4924.946 4924.110 4215.667 5896.161 5890.188 4903.472

Hence $5\,o - 6j = -50.920$; $6j - 7\,e = -28.115$; $7\,e - 5\,o = 79.035$

(27) $\frac{5}{6}$ 6 ob. 5270.501 5269.713 4376.107

Hence $5\,l - 6\,f = 93.893$

(28) $\frac{4}{5}$ 6 ob.

5914.389 5896.151 5890.190 4703.160 4691.569 4690.318 5862.586 5859.815 4683.739

Hence $4\,o - 5\,h = 108.596$

(29) $\frac{3}{4}$ 4 ob.

6569.455 4924.953 4294.109 6563.050 6546.494 4903.477 4859.911 6462.799 4824.291
4823.667

Hence $3\,q - 4j = 28.704$

(30) $\begin{smallmatrix}4\\5\\6\end{smallmatrix}$ 6 ob.

6594.108 6593.164 5270.500 5269.720 6569.438 6563.060 5250.825 5250.398 4376.100

Hence $4\,r - 4\,q = 109.548$; $4\,q - 5\,l = -85.554$; $5\,l - 6\,f = 93.950$; $4\,q - 6\,f = 8.396$

(31) $\frac{3}{4}$ 12 ob. Excellent.

6884.080 5162.456

SIX-INCH CONCAVE GRATING, 21½ FEET FOCUS.

10,000 lines to inch.

$\frac{2}{3}$ Slit wide open to see *A*, so that definition was poor.

		A.		
5068.957	7621.300	5083.523	5090.974	5105.730
5068.943	7621.245	5083.513	5090.955	5105.709

TABLE VI.

COLLECTION OF OBSERVATIONS FROM ABOVE.

e.

Wt.	Ob.	
1	(8)	$4e - 3n = 2.552$
1	(8)	$= 2.538$
		$4e - 3n = 2.545$

Wt.	Ob.	
1	(6)	$5e - 4l = 14.739$
	(2)	$= 14.776$
1	(4 *R*)	$= 14.635$
		$5e - 4l = 14.691$

Ob	
(6)	$5e - 3t = 3.684$
(2)	$= 3.642$
	$5e - 3t = 3.673$

Ob.	
(8)	$6e - 5k = -9.262$

Wt.	Ob.	
2	(8)	$6e - 4p = +31.808$
	(1.5)	$= 31.776$
1	(04)	$= 31.800$
	(010)	$= 31.902$
	(07)	$= 31.878$
	(04)	$= 31.796$
		$6e - 4p = 31.812$
		$\therefore 3e - 2p = 15.906$

Wt.	Ob.	
1	(4)	$7e - 6j = 28.009$
	(4)	$= 27.999$
1	(4 *R*)	$= 28.115$
		$7e - 6j = 28.060$

Wt.	Ob	
1	(4)	$7e - 5o = 78.956$
	(4)	$= 79.042$
1	(4 *R*)	$= 79.035$
		$7e - 5o = 79.017$

f.

Ob.	
(6 *R*)	$6f - 5l = -93.893$
(6 *R*)	$= -93.950$
	$6f - 5l = -93.921$

Ob	
(6 *R*)	$6f - 4q = -8.396$
(010)	$= -8.386$
(010)	$= -8.440$
	$6f - 4q = -8.407$

g.

Ob.	
(6)	$5g - 4n = 13.550$
(4 *R*)	$= 13.512$
	$5g - 4n = 13.531$
(4)	$7g - 6l = -104.413$

Ob.	
(8)	$6g - 5m = 5.581$

Wt.	Ob	
1	(8)	$6g - 4s = 12.290$
2	(04)	$= 12.326$
	(08)	$= 12.234$
	(010)	$= 12.260$
	(06)	$= 12.172$
		$6g - 4s = 12.258$

Ob.	
(4)	$7g - 5p = -86.633$

h.

Wt.	Ob.	
4	(8)	$6h - 5n = 23.137$
2	(4)	$= 23.216$
3	(6)	$= 23.179$
		$6h - 5n = 23.169$

Wt.	Ob.	
1	(4)	$6h - 4t = 23.656$
2	(08)	$= 23.548$
	(04)	$= 23.504$
	(06)	$= 23.548$
		$6h - 4t = 23.577$

Ob.	
(4)	$5h - 4o = -108.549$
(6 *R*)	$= -108.585$
(6 *R*)	$= -108.596$
	$5h - 4o = -108.577$

j.

Wt.	Ob.		Ob.		Ob.	
1	(4)	$6j - 5o = 50.947$	(4)	$6j - 7e = -28.009$	(4 *R*)	$4j - 3q = -28.704$
1	(4)	$= 51.043$	(4)	$= -27.999$		
1	(4 *R*)	$= 50.920$	(4 *R*)	$= -28.115$		
		$6j - 5o = 50.970$		$6j - 7e = -28.060$		

k.

Ob.		Ob.	
(8)	$5k - 4p = 41.070$	(8)	$5k - 6e = 9.262$

l.

Ob.		Ob.		Ob.		Ob.	
(8)	$6l - 5p = 17.779$	(4)	$6l - 7g = 104.413$	(6)	$4l - 5e = -14.739$	(6)	$4l - 8t = -11.055$
(8)	$= 17.779$			(2)	$= -14.776$	(2)	$= -11.134$
(4)	$= 17.791$			(4 *R*)	$= -14.635$		
(4)	$= 17.780$				$4l - 5e = -14.691$		$4l - 8t = -11.075$
		(6)	$5l - 4q = 85.486$	(6 *R*)	$5l - 6f = 93.893$		
		(6 *R*)	$= 85.554$	(6 *R*)	$= 93.950$		
	$6l - 5p = 17.781$		$5l - 4q = 85.520$		$5l - 6f = 93.921$		

m.

Ob.		Ob.	
(8)	$5m - 6g = -5.581$	(8)	$5m - 4s = 6.709$

n.

Ob.		Ob.		Wt.	Ob.	
(8)	$3n - 4e = -2.552$	(8)	$5n - 6h = -23.137$	1	(6)	$4n - 5g = -13.550$
(8)	$3n - 4e = -2.538$	(4)	$= -23.216$	1	(4 *R*)	$= -13.512$
		(6)	$= -23.179$			
	$3n - 4e = -2.545$		$5n - 6h = -23.169$			$4n - 5g = -13.531$
		(4)	$5n - 4t = .440$			
		(4)	$= .426$			
			$5n - 4t = .433$			

o.

Wt.	Ob.		Wt.	Ob.		Ob.	
1	(4)	$4o - 5h = 108.549$	1	(4)	$5o - 6j = -50.947$	(4)	$5o - 7e = -78.956$
1	(6 *R*)	$= 108.585$	1	(4)	$= -51.043$	(4)	$= -79.042$
1	(6 *R*)	$= 108.596$	1	(4 *R*)	$= -50.920$	(4 *R*)	$= -79.035$
		$4o - 5h = 108.577$			$5o - 6j = -50.970$		$5o - 7e = -79.017$

p.

Ob.		Ob.		Ob.		Ob.	
(8)	$5p - 6l = -17.779$	(4)	$5p - 7g = 86.633$	(8)	$4p - 5k = -41.070$	(8)	$4p - 6e = -31.808$
(8)	$= -17.779$					(15)	$= -31.776$
(4)	$= -17.791$					(04)	$= -31.800$
(4)	$= -17.780$					(010)	$= -31.902$
						(07)	$= -31.878$
						(04)	$= -31.796$
	$5p - 6l = -17.781$						$4p - 6e = -31.812$

q.

Ob.		Ob.		Ob.	
(6)	$4q - 5l = -85.486$	(4 *R*)*	$3q - 4j = 28.704$	(6 *R*)	$4q - 6f = 8.396$
(6 *R*)	$= -85.554$			(010)	$= 8.386$
				(010)	$= 8.440$
(6)	$4q - 5l = -85.520$				$4q - 6f = 8.407$

(6 *R*) $4q - 4p = -109.548$

r.

(6 *R*) $4r - 4q = 109.548$

s.

Ob.		Ob.	
(8)	$4s - 5m = 6.709$	(8)	$4s - 6g = -12.290$
		(04)	$= -12.336$ }
		(08)	$= -12.234$ }
		(016)	$= -12.260$ }
		(06)	$= -12.172$ }
			$4s - 6g = -12.258$

t.

Ob.		Ob.		Ob.		Ob.	
(6)	$3t - 4l = 11.055$	(6)	$3t - 5e = -3.684$	(4)	$4t - 5n = -.440$	(4)	$4t - 6h = -23.656$
(2)	$= 11.134$	(2)	$= -3.642$	(4)	$= -.426$	(08)	$= -23.548$
						(04)	$= -23.504$
						(06)	$= -23.548$
	$3t - 4l = 11.075$		$3t - 5e = -3.673$		$4t - 5n = -.433$		$4t - 6h = -23.577$

TABLE VII.

Wt.	*e*	*f*	*g*	*h*	*j*	*k*	*l*	*m*	*n*	*o*	*p*	*q*	*s*	*t*	*o′*	
2	4 *e*								−3 *n*							= 2.545
3	5 *e*						−4 *l*									= 14.691
1	5 *e*													−3 *t*		= 3.673
2	6 *e*					−5 *k*										= −9.262
5×2	3 *e*										−2 *p*					= 15.906
3	7 *e*				−6 *j*											= 28.060
3	7 *e*									−5 *o*						= 79.017
3		6 *f*					−5 *l*									= −93.921
4		6 *f*										−4 *q*				= −8.407
3			5 *g*						−4 *n*							= 13.531
2			6 *g*					−5 *m*								= 5.581
4×2			3 *g*										−2 *s*			= 6.129
3				6 *h*					−5 *n*							= 23.169
3×2				3 *h*										−2 *t*		= 11.788
4				5 *h*						−4 *o*						= −108.577
1			7 *g*								−5 *p*					= −86.633
3					6 *j*					−5 *o*						= 50.970
1					4 *j*							−3 *q*				= −28.704
2						5 *k*					−4 *p*					= 41.070
4							6 *l*				−5 *p*					= 17.781
3							5 *l*					−4 *q*				= 85.520
1			−7 *g*				6 *l*									= 104.413
1							4 *l*							−3 *t*		= −11.075
2								5 *m*					−4 *s*			= 6.709
2			−4 *g*						5 *n*					−4 *t*		= .433
2															3 *o′*	= 16.275

TABLE VIII.

FIRST CALCULATION.

$e = 4219.024$

Wt.			
5	$3e = 12657.072$ -15.906	$2)12641.166 = 6320.583 = p$
2	$4e = 16876.096$ -2.545	$3)16873.551 = 5624.517 = n$
3	$5e = 21095.120$ -14.691	$4)21080.429 = 5270.107 = l$
2	$6e = 25314.144$ $+9.262$	$5)25323.406 = 5064.681 = k$
3	$7e = 29533.168$ -28.060	$6)29505.108 = 4917.518 = j$
3	$7e = 29533.168$ -79.017	$5)29454.151 = 5890.830 = o$
1	$5e = 21095.120$ -3.673	$3)21091.447 = 7030.482 = t$

(5) $p = 6320.583$

1	$5p = 31602.915$ -86.633	$7)31516.282 = 4502.326 = g$	1
2	$4p = 25282.332$ $+41.070$	$5)25323.402 = 5064.680 = k$	2
4	$5p = 31602.915$ $+17.781$	$6)31620.696 = 5270.116 = l$	4

(2) $n = 5624.517$

3	$5n = 28122.585$ $+23.169$	$6)28145.754 = 4690.959 = h$	1
2	$5n = 28122.585$ $-.433$	$4)28122.152 = 7030.538 = t$	1
3	$4n = 22498.068$ $+13.531$	$5)22511.599 = 4502.320 = g$	1

(3) $l = 5270.107$

3	$5l = 26350.535$ -93.921	$6)26256.614 = 4376.102 = f$	2
4	$6l = 31620.642$ -17.781	$5)31602.861 = 6320.572 = p$	2
3	$5l = 26350.535$ -85.520	$4)26265.015 = 6566.254 = q$	2
1	$6l = 31620.642$ -104.413	$7)31516.229 = 4502.318 = g$	1
1	$4l = 21080.428$ $+11.075$	$3)21091.503 = 7030.501 = t$	1

(2) $k = 5064.681$

2	$5k = 25323.405$ -41.070	$4)25282.335 = 6320.584 = p$	1

(3) $j = 4917.518$

3	$6j = 29505.108$ -50.970	$5)29454.138 = 5890.828 = o$	2
1	$4j = 19670.072$ $+28.704$	$3)19698.776 = 6566.259 = q$	1

(3) $o = 5890.830$

4	$4o = 23563.320$ -108.577	$5)23454.743 = 4690.949 = h$	2
3	$5o = 29454.150$ $+50.970$	$6)29505.120 = 4917.520 = j$	2

Collecting.

	Wt.			Wt.
e	10	4219.024	4219.024	10
f	2	4376.102	4376.102	2
g	1	4502.326		
	1	.320		
	1	.318	4502.321	3
h	1	4690.959		
	2	.949	4690.952	3
j	3	4917.518		
	2	.520	4917.519	5
k	2	5064.681		
	2	.680	5064.681	4
l	3	5270.107		
	4	.116	5270.112	7
n	2	5624.517	5624.517	2
o	3	5890.830		
	2	.828	5890.829	5
p	5	6320.583		
	2	.572		
	1	.584	6320.580	8
q	2	6566.254		
	1	.259	6566.256	3
t	1	7030.482		
	1	.538		
	1	.501	7030.507	3

(10). $e = 4219.024$

Wt.		
3	$j = 4917.518$	2
2	$k = 5064.681$	2
3	$l = 5270.107$	2
2	$n = 5624.517$	2
3	$o = 5890.830$	2
5	$p = 6320.583$	3
1	$t = 7030.482$	1

(2) $f = 4376.102$

3	$6f = 26256.612$ $+ 93.921$	$5)26350.533 = 5270.107 = l$	2
4	$6f = 26256.612$ $+ 8.407$	$4)26265.019 = 6566.255 = q$	2

(3) $g = 4502.321$

3	$5g = 22511.605$ $- 13.531$	$4)22498.074 = 5624.518 = n$	2
2	$6g = 27013.926$ $- 5.581$	$5)27008.345 = 5401.669 = m$	1
4	$3g = 13506.963$ $- 6.129$	$2)13500.834 = 6750.417 = s$	2
1	$7g = 31516.247$ $+ 86.633$	$5)31602.880 = 6320.576 = p$	1

(3) $h = 4690.952$

3	$6h = 28145.658$ -23.169	$5)28122.489 = 5624.509 = n$	(2)
3	$3h = 14072.829$ -11.788	$2)14061.041 = 7030.534 = t$	(2)
4	$5h = 23454.715$ $+108.577$	$4)23563.292 = 5890.834 = o$	(2)

(5) $j = 4917.519$

3	$6j$ 29505.114 $+28.060$	$7)29533.174 = 4219.025 = e$	2
3	$6j = 29505.114$ -50.970	$5)29454.144 = 5890.829 = o$	2
1	$4j = 19670.076$ $+28.704$	$3)19698.780 = 6566.260 = q$	1

(2) $k = 5064.681$

2	$4219.024 = e$	(1)
2	$6320.584 = p$	(1)

(7) $l = 5270.112$

3	$4l = 21080.448$ $+14.691$	$5)21095.139 = 4219.028 = e$	(3)
3	$5l = 26350.560$ -93.921	$6)26256.639 = 4376.106 = f$	(3)
4	$6l = 31620.672$ -17.781	$5)31602.891 = 6320.578 = p$	(3)
3	$5l = 26350.560$ -85.520	$4)26265.040 = 6566.260 = q$	(3)
1	$6l = 31620.672$ -104.413	$7)31516.259 = 4502.323 = g$	1
1	$4l = 21080.448$ $+11.075$	$3)21091.523 = 7030.508 = t$	1

(2) $n = 5624.517$

2	$3n = 16873.551$	$4)16876.096 = 4219.024 = e$	1
	$+2.545$		
3	$4n = 22498.068$	$5)22511.599 = 4502.320 = g$	1
	$+13.531$		
3	$5n = 28122.585$	$6)28145.754 = 4690.959 = h$	1
	$+23.169$		
2	$5n = 28122.585$	$4)28122.152 = 7030.538 = t$	1
	-0.433		

(5) $o = 5890.829$

3	$5o = 29454.145$	$7)29533.162 = 4219.023 = e$	2
	$+79.017$		
4	$4o = 23563.316$	$5)23454.739 = 4690.948 = h$	2
	-108.577		
3	$5o = 29454.145$	$6)29505.115 = 4917.519 = j$	2
	$+50.970$		

(8) $p = 6320.580$

5	$2p = 12641.160$	$3)12657.066 = 4219.022 = e$	3
	$+15.906$		
1	$5p = 31602.900$	$7)31516.267 = 4502.324 = g$	1
	-86.633		
2	$4p = 25282.320$	$5)25323.390 = 5064.678 = k$	2
	$+41.070$		
4	$5p = 31602.900$	$6)31620.681 = 5270.113 = l$	3
	$+17.781$		

(3) $q = 6566.256$

4	$4q = 26265.024$	$6)26256.617 = 4376.103 = f$	2
	-8.407		
1	$3q = 19698.768$	$4)19670.064 = 4917.516 = j$	1
	-28.704		
3	$4q = 26265.024$	$5)26350.544 = 5270.109 = l$	2
	$+85.520$		

Résumé.— First Calculation.

e	2	4219.025		
	3	.028		
	1	.024		
	2	.023		
	3	.022		
	1	.024	4219.025	(12)
f	3	4376.106		
	2	.103	4376.105	(5)
g	1	4502.323		
	1	.320		
	1	.324	4502.322	(3)
h	1	4690.959		
	2	.948	4690.952	(3)
j	2	4917.518		
	2	.519		
	1	.516	4917.518	(5)
k	2	5064.681		
	2	.678	5064.680	(4)
l	2	5270.107		
	2	.107		
	3	.113		
	2	.109	5270.109	(9)
m	1	5401.669	5401.669	(1)
n	2	5624.517		
	2	.518		
	2	.509	5624.515	(6)
o	2	5890.830		
	2	.834		
	2	.829	5890.831	(6)
p	3	6320.583		
	1	.576		
	1	.584		
	3	.578	6320.580	(8)
q	2	6566.255		
	1	.260		
	3	.260	6566.258	(6)
s	2	6750.417	6750.417	(2)
t	1	7030.482		
	2	.534		
	1	.508		
	1	.538	7030.519	(5)

SECOND CALCULATION.

$o = 5890.830$

4	$4o = 23563.320$	$5)23454.743 = 4690.949 = h$	4
	-108.577		
3	$5o = 29454.150$	$6)29505.120 = 4917.520 = j$	3
	$+50.970$		
3	$5o = 29454.150$	$7)29533.167 = 4219.024 = e$	3
	$+79.017$		

(4) $4690.949 = h$

3	$6h = 28145.694$	$5)28122.525 = 5624.505 = n$	2
	-23.169		
3	$6h = 28145.694$	$4)28122.117 = 7030.529 = t$	2
	-23.577		

(3) $4917.520 = j$

1	$4j = 19670.080$	$3)19698.784 = 6566.261 = q$	1
3	$+28.704$	$4219.026 = e$	2

(3) $4219.024 = e$

2	$4e = 16876.096$	$3)16873.551 = 5624.517 = n$	1
	-2.545		
3	$5e = 21095.120$	$4)21080.429 = 5270.107 = l$	2
	-14.691		
1	$5e = 21095.120$	$3)21091.447 = 7030.482 = t$	1
	-3.673		
5	$3e = 12657.072$	$2)12641.166 = 6320.583 = p$	2
	-15.906		
2	$6e = 25314.144$	$5)25323.406 = 5064.681 = k$	1
	$+9.262$		
3	$7e = 29533.168$	$6)29505.108 = 4917.518 = j$	2
	-28.060		

e	3	4219.024		
	2	.026	4219.025	(5)
h	4	4690.949	4690.949	(4)
j	3	4917.520		
	2	.518	4917.519	(5)
k	1	5064.681	5064.681	(1)
l	2	5270.107	5270.107	(2)

n	2	5624.505		
	1	.517	5624.509	(3)
o		5890.830	5890.830	
p	2	6320.583	6320.583	(2)
q	1	6566.261	6566.261	(1)
t	1	7030.482		
	2	.529	7030.513	(3)

$e = 4219.025$ (3)

(2)	$4e = 16876.096$ -2.545	$3)16873.551 = 5624.518 = n$	(1)
(3)	$5e = 21095.120$ -14.691	$4)21080.429 = 5270.108 = l$	(2)
(1)	$5e = 21095.120$ -3.673	$3)21091.447 = 7030.483 = t$	(1)
(5)	$3e = 12657.072$ -15.906	$2)12641.166 = 6320.584 = p$	(2)
(2)	$6e = 25314.144$ $+9.262$	$5)25323.406 = 5064.682 = k$	(1)
(3)	$7e = 29533.168$ -28.060	$6)29505.108 = 4917.519 = j$	(2)
(3)	$7e = 29533.167$ -79.017	$5)29454.150 = 5890.831 = o$	(2)

$h = 4690.949$ (4)

(3)	$6h = 28145.694$ -23.169	$5)28122.525 = 5624.505 = n$	(2)
(3)	$6h = 28145.694$ -23.577	$4)28122.117 = 7030.529 = t$	(2)
(4)	$5h = 23454.743$ $+108.577$	$4)23563.320 = 5890.830 = o$	(2)

$j = 4917.519$ (5)

(1)	$4j = 19670.076$ $+28.704$	$3)19698.780 = 6566.260 = q$	(1)
(3)	$6j = 29505.114$ $+28.060$	$7)29533.174 = 4219.025 = e$	(2)
(3)	$6j = 29505.114$ -50.970	$5)29454.144 = 5890.829 = o$	(2)

$k = 5064.681$ (1)

2	$5k = 25323.406$ -9.262	$6)25314.144 = 4219.024 = e$	(1)
2	$5k = 25323.406$ -41.070	$4)25282.336 = 6320.584 = p$	(1)

$l = 5270.107$ (2)

(3)	$4l = 21080.429$ $+14.691$	$5)21095.120 = 4219.024 = e$	(1)
(3)	$5l = 26350.535$ -85.520	$4)26265.015 = 6566.254 = q$	(1)
(4)	$6l = 31620.642$ -17.781	$5)31602.861 = 6320.572 = p$	(2)
(3)	$5l = 26350.535$ -93.921	$6)26256.614 = 4376.102 = f$	(1)
(1)	$6l = 31620.642$ -104.413	$7)31516.229 = 4502.318 = g$	(1)
(1)	$4l = 21080.429$ $+11.075$	$3)21091.504 = 7030.501 = t$	(1)

$n = 5624.509$ (3)

(2)	$3n = 16873.527$ $+2.545$	$4)16876.072 = 4219.018 = e$	(1)
(3)	$4n = 22498.036$ $+13.531$	$5)22511.567 = 4502.313 = g$	(2)
(3)	$5n = 28122.545$ $+23.169$	$6)28145.714 = 4690.952 = h$	(2)
(2)	$5n = 28122.545$ $-.433$	$4)28122.112 = 7030.528^{*} = t$	(1)

$o = 5890.830$ (10)

(4)	$4o = 23563.320$ -108.577	$5)23454.743 = 4690.949 = h$	(4)
(3)	$5o = 29454.150$ $+50.970$	$6)29505.120 = 4917.520 = j$	(3)
(3)	$5o = 29454.150$ $+79.017$	$7)29533.167 = 4219.024 = e$	(3)

$p = 6320.583$ (2)

(5)	$2p = 12641.166$ $+15.906$	$3)12657.072 = 4219.024 = e$	(2)
(1)	$5p = 31602.915$ -86.633	$7)31516.282 = 4502.326 = g$	(1)
(2)	$4p = 25282.332$ $+41.070$	$5)25323.402 = 5064.680 = k$	(1)
(4)	$5p = 31602.915$ $+17.781$	$6)31620.696 = 5270.116 = l$	(2)

$q = 6566.261$ (1)

(4)	$4q = 26265.044$ -8.407	$6)26256.637 = 4376.106 = f$	(1)
(1)	$3q = 19698.783$ -28.704	$4)19670.079 = 4917.520 = j$	(1)
(3)	$4q = 26265.044$ $+85.520$	$5)26350.564 = 5270.113 = l$	(1)

$g = 4502.317$ (4)

2	$6g = 27013.902$	$5)27008.321 = 5401.664 = m$	(1)
	-5.581		
4	$3g = 13506.951$	$2)13500.822 = 6750.411 = s$	(2)
	-6.129		

$s = 6750.411$ (2)

$4s = 27001.644$	$5)27008.353 = 5401.671$	(1)
$+6.709$		

$m = 5401.664$ (1)

$5m = 27008.320$	$4)27001.611 = 6750.403$
-6.709	

Résumé. — Second Calculation.

e	2	4219.025		
	2	.025		
	1	.024		
	1	.024		
	1	.018		
	3	.024		
	2	.024	4219.024	(10)
f	1	4376.102		
	1	.106	4376.104	(2)
g	1	4502.318		
	2	.313		
	1	.326	4502.317	(4)
h	2	4690.952		
	4	.949	4690.950	(6)
j	2	4917.519		
	3	.520		
	1	.520	4917.520	(6)
k	1	5064.682		
	1	.680	5064.681	(2)
l	2	5270.108		
	2	.116		
	1	.113	5270.112	(5)
m	1	5401.671		
	1	.664	5401.667	
n	1	5624.518		
	2	.505	5624.509	(3)
o	2	5890.831		
	2	.830		
	2	.829	5890.830	(6)
p	2	6320.584		
	1	.584		
	2	.572	6320.579	(5)
q	1	6566.260		
	1	.254	6566.257	(2)
s	2	6750.411		
	1	.403	6750.408	
	1	7030.483		
	2	.529		
	1	.501		
	1	.528	7030.514	(5)

TABLE IX.

TABLE OF PRIMARY STANDARDS.

	First.	Second.	Mean.	Relative Wave Lengths.	Absolute Standards.
e	4219.025	4219.024	4219.025	4215.667	4215.665
				4222.383	4222.381
f	4376.105	4376.104	4376.105	4376.105	4376.103
g	4502.322	4502.317	4502.320	4494.731	4494.729
				4497.050	4497.048
				4501.447	4501.444
				4508.462	4508.460
h	4690.952	4690.950	4690.951	4690.325	4690.323
				4694.577	4691.575
j	4917.518	4917.529	4917.519	4903.486	4903.484
				4924.112	4924.110
				4924.958	4924.956
k	5064.680	5064.681	5064.680	5060.253	5060.250
				5064.837	5064.834
				5068.949	5068.946
l	5270.109	5270.112	5270.110	5269.720	5269.717
				5270.500	5270.497
m	5401.669	5401.667	5401.668	5397.351	5397.250
				5405.985	5405.984
n	5624.515	5624.509	5624.512	5624.257	5624.254
				5624.767	5624.764
o	5890.831	5890.830	5890.830	5862.585	5862.582
				5890.187	5890.184
				5896.160	5896.157
				5914.389	5914.386
p	6320.580	6320.579	6320.580	6246.533	6246.530
				6318.244	6318.241
				6322.915	6322.912
q	6566.258	6566.257	6566.258	6563.052	6563.049
				6564.397	6564.394
				6569.464	6569.461
s	6750.417	6750.408	6750.412	6750.412	6750.409
t	7030.519	7030.514	7030.516	7023.754	7023.747
				7027.731	7027.724
				7040.063	7040.056

From the foregoing we also find the mean of *g* to be 7621.282, and the absolute standard 7621.278.

Determination of *A*.

By running the micrometer across from the first to the second spectrum of a grating with 21½ feet focus and 10,000 lines to the inch, I obtained the wave lengths of lines in *A* more accurately than had ever before been obtained, but still without the accuracy of the rest of the measures. The reason of this was the very long distance to be measured in an interval so very faint in light as to render it necessary to open the slit wide. The following results were obtained: —

		Mean.
7594.07	7593.98	7594.02
7621.30	.15	.22
7623.57	.38	.47
7624.86	.71	.78

A 10,000 grating was finally found in which the *A* line could be seen in the second spectrum, and hence its coincidence with the third spectrum determined.

But the slit had to be so wide as greatly to injure the definition. Besides, the green of the third spectrum was so bright as partly to blind the eyes to the *A* line when the proper absorbing medium was put in. However, fairly satisfactory results were obtained as follows: —

5068.964	7621.310	5083.530	5090.981	5105.737
5068.950	7621.255	5083.520	5090.962	5105.716
5068.957	7621.282	5083.525	5090.971	5105.726

Each of these is the mean of many readings, and the agreement is not specially good.

TABLE X.

Description of Table.

In the first column is the metal to which the line measured is supposed to belong. Where a solar line is measured, it often belongs to several metals, though the lines are rarely coincident. When they are apparently coincident, they are written on one line, thus, *Fe, Ti*. If the iron had coincided with the violet side and the *Ti* with the red side it would have been written thus: $^{Fe}_{Ti}>$. Had the iron line coincided with the violet side only, and the *Ti* not at all, it would have been written thus: $^{Fe}_{?}>$.

The column giving the intensity in the arc is a very rough attempt only at the intensity as it appeared on the plates, without attempting to define the strongest line by any fixed number. The stronger the line the larger the number. The intensities in the solar spectrum are also only roughly estimated.

In the next column the fifteen visible standards are placed together with the *A* line and another group at about 7200, which were used as standards in this difficult region. Next to these, wider sets of lines depending on these were used as the standards, so that the mean of a number of observations could be taken.

The eye observations are marked with letters *p, q, R, C,* etc.

The photographic plates, most of which have coincidences with the blue violet or ultra-violet, are marked Plate 1, Plate 2, etc., to Plate 23, and extend through the whole solar spectrum from wave line 3005 to 7201.

The plates having the solar spectrum and metallic spectra of different orders, or metallic spectra alone, are marked ⊙ M. 44 II, M. 29 III, M. 22 IV, etc., and were taken with a grating having 20,000 lines to the inch. The mark means that the solar and metallic spectra were taken at wave length 4400 in the second spectrum, and the metallic spectra at 2900 in the third, and 2200 in the fourth, were also on the plate.

The substandards are put in where required, in italic.

The small letters *a, b, c,* refer to the dividing engines used for measurement. ⊙ means solar, and *M* metallic, and *R* reversed.

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		⊙ M 44 II, M 29 III, M 22 IV							⊙ M 48 II, M 32 III, M 24 IV						
						Ca J c M	Sr J c M	Fe J c M	Si I′ J c M	Si H J a M	Si I J a M	Si J J a M	Mg J c M	Si J b M	Si J c M	† J b M	† J b M	C J b M	Sn J c M
Sr	2	. .	. .	M	2152	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Sr	3	. .	. .	M	2165	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	2	. .	. .	M	2208	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	3	. .	. .	M	2210	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	2	. .	. .	M	2211	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	4	. .	. .	M	2216	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	2	. .	. .	M	2218	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Al	3	. .	. .	M	2263	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Al	4	. .	. .	M	2269	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Sr	10	. .	R	M	2275	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ca	20	. .	R	M	2275	587	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe?	. .	. .	. .	M	2298	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ba	20	. .	R	M	2304	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ba	20	. .	R	M	2335	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2343	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2348	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2364	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Al	6	. .	. .	M	2367	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Al	7	. .	. .	M	2373	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2373	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe?	. .	. .	. .	M	2382	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2388	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe?	. .	. .	. .	M	2395	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ca	25	. .	R	M	2398	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2399	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2404	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2406	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2410	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	8	. .	. .	M	2435	. .	. .	. .	. .	. .	. .	. .	. .	242	249	233	. .	255	. .
Si	3	. .	. .	M	2438	. .	. .	. .	. .	. .	. .	. .	. .	. .	856	. .	. .	. .	. .
Si	3	. .	. .	M	2443	. .	. .	. .	. .	. .	. .	. .	. .	. .	452	. .	. .	. .	. .
Fe?	. .	. .	. .	M	2447	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	3	. .	. .	M	2452	. .	. .	. .	. .	. .	. .	. .	. .	. .	197	. .	. .	. .	. .
Fe?	. .	. .	. .	M	2457	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2462	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2472	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .

* The solar spectrum at 48 was not used in this series, but only the metal spectrum at 32.

† These results were obtained by interpolation between the Mg lines at 4571 and 4703 at one end, and 5172 and 5183 at the other, using the theoretical correction for length of plate. The Mg lines, and the Bo and Si were in the 1st and 2nd spectra instead of the 2nd and 4th.

⊙ M 40 II, M 27 III					⊙ M 36 II, M 24 III								Sub-standard	M 24 I			Mean
Mg J a M	Mg J b M	Mg J b M	Si D J a M	Si E J a M	Si G J a M	Si G J a M	Si G J c M	Si F J a M	Si F J c M	Ca J c M	Fe J c M	Th J c M		Sr J c M	Ba J c M	Ca r c M	M
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	912	. .	. .	912
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	990	. .	. .	990
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	034	. .	086	060
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	928	. .	950	939
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	758	. .	760	759
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	759	. .	760	760
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	126	. .	165	146
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	487	. .	526	507
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	140	. .	183	161
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	376	. .	. .	376
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	616	602
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	234	. .	257	246
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	264	. .	364
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	267	. .	267
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	562	. .	579	571
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	899	. .	871	885
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	882	. .	912	897
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	139	147	146	144
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	195	237	207	213
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	754	. .	787	771
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	114	117	135	122
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	703	. .	717	710
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	698	726	722	715
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	670	. .	. .	. .	647	672	678	667
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	301	. .	354	328
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	963	. .	979	971
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	729	. .	756	743
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	603	. .	605	604
. .	. .	. .	. .	. .	248	248	250	251	260	. .	256	. .	*243*	228	234	256	247
. .	. .	. .	. .	. .	871	867	871	870	880	. .	. .	. .	*865*	858	840	865	864
. .	. .	. .	. .	. .	461	462	468	470	478	. .	. .	. .	*460*	446	. .	445	460
. .	. .	. .	. .	. .	. .	. .	775	. .	. .	. .	. .	. .	. .	771	. .	808	785
. .	. .	. .	. .	. .	215	217	220	220	232	. .	. .	. .	*210*	211	. .	243	219
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	682	675	684	680
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	743	744	743	743
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	969	980	974	974

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		⊙ M 44 II, M 29 III, M 22 IV							⊙ M 48 II, M 32 III, M 24 IV						
						Ca J c M	Sr J c M	Fe J c M	Si I′ J c M	Si H J a M	Si I J a M	Si J J a M	Mg J c M	Si J b M	Si J c M	† J b M	† J b M	C J b M	Sn J c M
C	10	. .	. .	M	2478*	. .	. .	. .	. .	. .	. .	. .	. .	. .	660	647	. .	670	. .
Fe	. .	. .	. .	M	2479	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2483	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2484	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2488	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2489	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2490	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2491	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Bo	15	. .	. .	M	2496	. .	. .	. .	. .	. .	. .	. .	865	859	863	854	854	874	858
Bo	20	. .	. .	M	2497	. .	. .	. .	. .	. .	. .	. .	828	813	815	808	809	826	821
Fe	. .	. .	. .	M	2501	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	10	. .	. .	M	2506	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	980	984	004	. .
Fe	. .	. .	. .	M	2510	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	7	. .	. .	M	2514	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	402	403	. .	. .
Si	15	. .	. .	M	2516	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	203	206	. .	. .
Fe	. .	. .	. .	M	2518	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	8	. .	. .	M	2519	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	289	292	. .	. .
Fe	. .	. .	. .	M	2522	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	9	. .	. .	M	2524	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	198	208	. .	. .
Fe	. .	. .	. .	M	2527	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	606	. .	. .
Si	10	. .	. .	M	2528	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	595	. .	. .	. .
Fe	. .	. .	. .	M	2535	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Hg	100	. .	R	M	2536	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2541	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2546	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2549	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Al	. .	. .	. .	M	2568	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Al	. .	. .	. .	M	2575	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mn	. .	. .	. .	M	2576	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe?	. .	. .	. .	M	2584	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2585	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mn	. .	. .	. .	M	2593	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2598	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2599	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2611	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2631	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Si	5	. .	. .	M	2631	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .

* This line seems to be the only single line of carbon not belonging to a band in the arc spectrum. It was determined to belong to *c* by the spark spectrum.

† These results were obtained by interpolations between the Mg lines at 4571 and 4703 at one end, and 5172 and 5183 at the other, using the theoretical correction for length of plate. The Mg lines and the Bo and Si were in the 1st and 2nd spectra instead of the 2nd and 4th.

⊙ M 40 II, M 27 III					⊙ M 36 II, M 24 III								Sub-standard	M 24 I			Mean
Mg J a M	Mg J b M	Mg J b M	Si D J a M	Si E J a M	Si G J a M	Si G J a M	Si G J c M	Si F J a M	Si F J c M	Ca J c M	Fe J c M	Th J c M		Sr J c M	Ba J c M	Ca J c M	M
. .	. .	. .	. .	. .	. .	. .	666	. .	658	. .	660	. .	*660*	658	677	655	661
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	860	878	874	871
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	351	371	355	359
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	286	280	283	283
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	237	243	234	238
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	828	839	847	838
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	706	733	731	723
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	240	247	246	244
. .	. .	. .	. .	. .	. .	. .	873	. .	872	876	869	872	*867*	877	874	871	867
. .	. .	. .	. .	. .	. .	. .	828	. .	826	827	835	826	*823*	817	820	821	821
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	218	223	228	223
. .	. .	. .	. .	. .	. .	. .	006	. .	011	. .	. .	998	000	000	990	991	994
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	931	944	928	934
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	416	. .	422	444	415	417
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	227	212	204	210
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	199	175	190	188
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	298	. .	292	312	296	297
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	949	949	945	948
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	209	. .	210	215	195	206
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	530	538	521	530
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	615	680	597	599
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	702	693	702	699
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	625	671	. .	648
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	065	044	064	058
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	064	076	063	068
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	704	. .	703	704
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	089	086	079	085
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	198	208	188	198
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	200	. .	189	195
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	631	. .	626	629
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	965	. .	961	963
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	812	. .	808	810
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	470	. .	450	460
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	494
. .	. .	. .	493	494	. .	. .	. .	. .	. .	. .	. .	. .	. .	964	. .	965	965
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	110	. .	139	125
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*383*	390	381	425	392
. .	. .	. .	382	383	. .	. .	. .	. .	. .	. .	. .	. .					

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		⊙ M 44 II, M 29 III, M 22 IV						
						Ca J c M	Sp J c M	Fe J c M	Si I′ J c M	Si H J a M	Si I J a M	Si J J a M
Fe	. .	. .	. .	M	2679	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2706	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2719	. .	. .	. .	. .	.	. .	. .
Fe	. .	. .	. .	M	2720	. .	. .	. .	. .	. .	. .	. .
Ca	5	. .	. .	M	2721	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2723	. .	. .	. .	. .	. .	. .	. .
Fe?	. .	. .	. .	M	2733	. .	. .	. .	. .	. .	. .	. .
Fe?	. .	. .	. .	M	2737	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2742	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2750	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2755	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2756	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2761	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2762	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2767	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2772	. .	. .	. .	. .	. .	. .	. .
Mg	5	. .	R	M	2776	. .	. .	. .	. .	. .	. .	. .
Mg	5	. .	R	M	2778	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2778	. .	. .	. .	. .	. .	. .	. .
Mg	8	. .	R	M	2779	. .	. .	. .	. .	. .	. .	. .
Mg	5	. .	R	M	2781	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2781	. .	. .	. .	. .	. .	. .	. .
Mg	5	. .	R	M	2783	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2788	. .	. .	. .	. .	. .	. .	. .
Mn	. .	. .	. .	M	2794	. .	. .	. .	. .	. .	. .	. .
Mg	20	. .	R	M	2795	638	629	. .	639	. .	. .	. .
Mn	. .	. .	. .	M	2798	. .	. .	. .	. .	. .	. .	. .
Mn	. .	. .	. .	M	2801	. .	. .	. .	. .	. .	. .	. .
Mg	20	. .	R	M	2802	816	808	. .	. .	. .	. .	. .
Fe	5	. .	. .	M	2813	388	375	. .	398	. .	. .	. .
Fe	3	. .	. .	M	2823	389	. .	. .	. .	. .	. .	. .
Fe	5	. .	. .	M	2825	667	. .	. .	. .	. .	. .	. .
Fe	4	. .	. .	M	2832	549	. .	549	549	. .	. .	. .
Fe	3	. .	. .	M	2838	226	. .	. .	. .	. .	. .	. .
Fe	3	. .	. .	M	2843	744	. .	. .	. .	. .	. .	. .
Fe	5	. .	. .	M	2844	082	. .	080	083	. .	. .	. .
Fe	6	. .	. .	M	2851	906	. .	908	902	. .	. .	. .
Mg	100	. .	R	M	2852	236	239	241	234	235	240	. .

⊙ M 48 II, M 32 III, M 22 IV						⊙ M 40 II, M 27 III						M 24 I			
Ba M	Mg J c M	Si J b M	Si J c M	C J b M	Sn J c M	Mg J a M	Mg J b M	Mg J b M	Si D J a M	Si E J a M	Sub-standard	Sp J c M	Ba J c M	Ca J c M	Mean M
..	..	..	..	..	..	..	..	..	..	..	..	159	126	159	148
..	..	..	..	..	..	..	..	..	..	..	..	700	..	667	684
..	..	..	..	..	..	..	..	..	..	..	..	133	108	116	119
..	..	..	..	..	..	..	..	..	..	..	..	996	986	984	989
..	..	..	..	..	..	..	..	..	..	..	..	..	..	762	762
..	..	..	..	..	..	..	..	..	..	..	..	682	658	664	668
..	..	..	..	..	..	..	..	..	..	..	..	690	657	671	673
..	..	..	..	..	..	..	..	..	..	..	..	416	405	395	405
..	..	..	..	..	..	..	..	..	..	..	..	510	473	472	485
..	..	..	..	..	..	..	..	..	..	..	..	240	237	233	237
..	..	..	..	..	..	..	..	..	..	..	..	840	..	823	837
..	..	..	..	..	..	..	..	..	..	..	..	428	411	443	427
..	..	..	..	..	..	..	..	..	..	..	..	871	..	881	876
..	..	..	..	..	..	..	..	..	..	..	..	081	..	139	110
..	..	..	..	..	..	..	..	..	..	..	..	638	..	621	630
..	..	..	..	..	..	..	..	..	..	..	..	208	..	203	206
..	..	..	..	..	..	800	801	801	..	..	*800*	793	..	793	798
..	..	..	..	..	..	383	381	380	..	..	*381*	..	..	..	381
..	..	..	..	..	..	..	..	..	..	..	..	355	..	325	340
..	..	..	..	..	..	938	935	933	..	..	*935*	948	..	933	935
..	..	..	..	..	..	525	523	515	..	..	*521*	516	..	525	521
..	..	..	..	..	..	..	..	..	..	..	..	..	..	945	945
..	..	..	..	..	..	080	077	074	..	..	*077*	075	..	081	077
..	..	..	..	..	..	..	..	..	..	..	..	209	195	199	201
..	..	..	..	..	..	..	..	..	..	..	..	908	920	905	911
..	..	..	..	..	..	628	630	626	..	..	*632*	647	624	627	632
..	..	..	..	..	..	..	..	..	..	..	..	370	366	371	369
..	..	..	..	..	..	..	..	..	..	..	..	189	178	183	183
..	..	..	..	..	..	800	802	796	..	..	*806*	806	803	807	805
..	..	..	..	..	..	..	..	..	..	..	*387*	401	382	386	388
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	389
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	667
..	..	..	..	..	..	..	..	..	..	..	..	535	544	541	545
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	226
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	744
..	..	..	..	..	..	..	..	..	..	..	..	088	092	082	085
..	..	..	..	..	..	..	..	..	..	..	..	898	..	..	904
..	..	..	..	..	..	..	..	..	..	..	..	238	249	233	239
240	..	..	..	..	..	..	..	..	..	..	..				

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		Pl 20 ⊙ 62 I ⊙ 31 II	⊙ M 44 II, M 29 III, M 22 IV								Substandard
						J c ⊙	Ca J c M	Sr J c M	Fe J c M	Si I' J c M	Si H J a M	Si I J a M	Si J J a M	Ba J c M	
Si	15	. .	. .	M	2881	. .	696	710	695	683	696	693	687	697	. .
Fe	7	. .	R	M	2912	. .	276	. .	280	270	. .	. .	. .	. .	. .
Fe	8	. .	R	M	2929	. .	118	. .	140	124	. .	. .	. .	. .	. .
Fe	10	. .	R	M	2937	. .	016	008	037	017	. .	. .	. .	. .	. .
Fe	8	. .	R	M	2947	. .	998	984	999	992	. .	. .	. .	. .	. .
Fe	7	. .	R	M	2954	. .	062	050	056	063	. .	. .	. .	. .	. .
Fe	5	. .	. .	M	2957	. .	485	. .	489	481	. .	. .	. .	. .	. .
Fe	5	. .	. .	M	2965	. .	380	. .	382	381	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	2966	. .	985	. .	. .	. .	. .	. .	. .	. .	. .
Fe	8	. .	R	M	2967	. .	. .	012	021	015	013	013	015	017	*015*
Fe	4	. .	R	M	2970	. .	213	. .	229	221	. .	. .	. .	. .	*221*
Fe	6	. .	R	M	2973	. .	251	. .	257	252	255	255	252	. .	*254*
Fe	12	. .	R	M	2973	. .	358	345	349	355	361	353	356	369	*356*
Fe	2	. .	. .	M	2981	. .	566	. .	573	561	. .	. .	. .	. .	. .
Fe	10	. .	R	M	2983	. .	691	680	695	688	688	687	686	695	*689*
Fe	. .	. .	. .	M	2987	. .	410	. .	. .	. .	. .	. .	. .	. .	. .
Si	4	. .	. .	M	2987	. .	773	. .	. .	763	766	765	763	. .	*766*
Fe	8	. .	R	M	2994	. .	545	550	550	544	549	547	542	556	*548*
Ca	7	. .	R	M	2995	. .	076	. .	. .	. .	. .	. .	. .	. .	. .
Ca	10	. .	R	M	2997	. .	429	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	. .	R	M	2999	. .	633	. .	639	631	. .	. .	. .	. .	. .
Ca	6	. .	R	M	2999	. .	764	. .	. .	. .	. .	. .	. .	. .	. .
Ca	8	. .	R	M	3000	. .	973	. .	. .	. .	. .	. .	. .	. .	. .
Fe	8	. .	R	M	3001	. .	079	. .	072	067	068	065	065	068	*069*
	. .	. .	. .	⊙	3005	160	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	. .	. .	⊙	3005	404	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ca	15	. .	R	M	3006	. .	980	. .	. .	. .	. .	. .	. .	. .	. .
Fe	2	. .	. .	M	3007	. .	260	. .	. .	. .	. .	. .	. .	. .	. .
Fe	1	. .	. .	M	3007	. .	403	. .	411	409	. .	. .	. .	. .	. .
Fe	6	. .	R	M	3008	. .	258	251	264	258	260	254	246	. .	*256*
Ca	7	. .	R	M	3009	. .	330	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	. .	R	M	3009	. .	696	. .	698	693	. .	. .	. .	. .	. .
	. .	4	. .	⊙'	3012	548	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	6	. .	⊙'	3014	245	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	3	. .	M	3016	. .	296	. .	. .	. .	. .	. .	. .	. .	. .

M 24 I			⊙ M 32 II															Mean	
Sr J c M	Ba J c M	Ca J c M	Prd J b ⊙	Prd J b M	Ca J c ⊙	Ca J c M	Ba J b ⊙	Ba J b M	Sr J b ⊙	Sr J b M	Co J b ⊙	Co J b M	Si J b ⊙	Si J b M				⊙	M
. .	. .	702	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				. .	695
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				. .	275
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				. .	127
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				. .	020
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				. .	993
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				. .	058
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				. .	485
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				. .	381
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				. .	985
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	019	. .	016	. .	. .				. .	016
. .	. .	. .	. .	. .	. .	229	. .	. .	. .	. .	. .	224	. .	. .				. .	223
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				. .	254
. .	. .	. .	. .	. .	. .	368	. .	. .	. .	. .	. .	870	. .	. .				. .	358
. .	. .	. .	. .	. .	. .	578	. .	. .	. .	. .	. .	. .	. .	. .				. .	570
. .	. .	. .	. .	. .	. .	699	. .	. .	. .	687	. .	684	. .	. .				. .	689
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				. .	410
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				. .	766
. .	. .	. .	. .	559	. .	547	. .	554	. .	543	. .	555	. .	519				. .	547
. .	. .	. .	. .	. .	. .	081	. .	. .	. .	. .	. .	. .	. .	. .				. .	074
. .	. .	. .	. .	. .	. .	430	. .	. .	. .	. .	. .	. .	. .	. .				. .	430
. .	. .	. .	. .	. .	. .	. .	. .	623	. .	. .	. .	. .	. .	. .				. .	632
. .	. .	. .	. .	. .	. .	769	. .	. .	. .	. .	. .	. .	. .	. .				. .	767
. .	. .	. .	. .	. .	. .	979	. .	. .	. .	. .	. .	. .	. .	. .				. .	976
. .	. .	. .	. .	072	. .	. .	. .	071	. .	060	. .	. .	. .	082				. .	070
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				160	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				404	. .
. .	. .	. .	. .	. .	. .	975	. .	. .	. .	. .	. .	. .	. .	. .				. .	978
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				. .	260
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				. .	408
. .	. .	. .	. .	259	. .	258	. .	256	. .	239	. .	. .	. .	255				. .	255
. .	. .	. .	. .	. .	. .	324	. .	. .	. .	. .	. .	. .	. .	. .				. .	327
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				. .	696
. .	. .	. .	560	. .	. .	. .	. .	. .	. .	. .	564	. .	. .	. .				557	. .
. .	. .	. .	301	. .	. .	. .	. .	. .	. .	. .	277	. .	. .	. .				274	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .				. .	296
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .					

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		Pl 20 ⊙62 I ⊙31 II	⊙ M 44 II, M 29 III, M 22 IV								⊙ M 48 II, M 32 III, M 24 IV				Substandard
						J c ⊙	Ca J c M	Sr J c M	Fe J c M	Si J c M	Si J a M	Si J a M	Si J a M	Ba J c M	Mg J c M	Si b_2 J b M	Si c_2 J c M	Ni J c M	
Fe	5	. .	. .	M	3017	. .	747	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	5	. .	. .	M	3019	. .	109	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	3019	. .	752	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	10	. .	R	M	3020	. .	610	600	619	613	. .	. .	. .	. .	. .	. .	. .	. .	*610*
Fe	25	. .	R	M	3020	. .	760	754	765	761	. .	. .	. .	765	. .	. .	. .	. .	*761*
Fe	15	. .	R	M	3021	. .	194	186	193	198	. .	. .	. .	201	. .	. .	. .	. .	*194*
Fe	7	7	R	M	3024	. .	154	. .	165	156	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	5	. .	⊙′	3024	462	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	4	. .	⊙′	3025	387	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	10	10	R	M	3025	. .	. .	. .	973	965	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	. .	. .	M	3027	. .	245	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	4	. .	⊙	3035	848	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	15	15	R	M	3037	. .	511	504	520	510	. .	. .	. .	. .	. .	. .	. .	. .	*509*
Ca	15	4	R	⊙,M	3044	115	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mn	10	3	R	⊙′	3044	687	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	3	. .	⊙′	3046	778	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	20	20	R	M	3047	. .	727	716	740	729	. .	. .	. .	. .	. .	. .	. .	. .	*728*
	. .	$d\frac{2}{3}$	. .	⊙″	3050	215	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe?	. .	3	. .	⊙′	3053	172	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	$d\frac{3}{4}$	. .	⊙′	3053	527	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	d?5	. .	⊙″	3055	817	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	10	10	R	M	3057	. .	566	. .	590	572	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	10	10	R	M	3059	. .	204	190	224	209	. .	. .	. .	. .	202	. .	196	. .	*204*
	. .	3	. .	⊙′	3061	098	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Co	8	3	R	⊙″	3061	930	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	10	10	R	M	3067	. .	363	350	396	374	. .	. .	. .	. .	. .	. .	352	. .	*367*
Ti	6	8	. .	M	3075	. .	330	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	10	10	R	M	3075	. .	835	. .	879	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	2	. .	M	3077	. .	. .	. .	216	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	4	. .	⊙	3077	292	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe?	. .	4	. .	⊙″	3078	142	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ti	4	6	. .	M	3078	. .	765	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mn	7	2	. .	⊙″	3079	724	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	5	. .	⊙″	3080	863	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Al	20	7	R	M	3082	. .	269	. .	. .	. .	. .	. .	. .	. .	294	261	270	276	. .

⊙ M 32 II												Sub-standard	⊙ 48 II, M 32 III, M 24 IV		Mean	
Prd J b ⊙	Prd J b M	Ca J c ⊙	Ca J c M	Ba J b ⊙	Ba J b M	Sr J b ⊙	Sr J b M	Co J b ⊙	Co J b M	Si J b ⊙	Si J b M	M	C J b M	Sn J c M	⊙	M
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	747
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	109
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	752
. .	610	. .	610	. .	619	. .	618	. .	600	. .	612	. .	. .	. .	. .	611
. .	762	. .	765	. .	764	. .	748	. .	752	. .	758	. .	. .	. .	. .	759
. .	192	. .	192	. .	194	. .	179	. .	185	. .	184	. .	. .	. .	. .	191
. .	. .	. .	142	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	154
491	. .	464	. .	. .	. .	. .	. .	481	. .	. .	. .	. .	. .	. .	475	. .
417	. .	388	. .	. .	. .	. .	. .	384	. .	. .	. .	. .	. .	. .	394	. .
. .	. .	. .	958	. .	944	. .	. .	. .	. .	. .	951	. .	. .	. .	. .	958
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	245
865	. .	842	. .	. .	. .	. .	. .	846	. .	. .	. .	. .	. .	. .	850	. .
493	. .	. .	495	. .	496	. .	. .	490	. .	. .	499	. .	. .	. .	492	505
130	. .	. .	. .	. .	. .	. .	. .	113	114	. .	. .	. .	. .	. .	119	114
682	. .	680	. .	. .	. .	. .	. .	681	. .	. .	. .	. .	. .	. .	688	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	778	. .
. .	727	. .	718	. .	703	. .	705	. .	. .	. .	718	. .	. .	. .	. .	720
220	. .	200	. .	. .	. .	. .	. .	212	. .	. .	. .	. .	. .	. .	212	.
172	. .	170	. .	. .	. .	. .	. .	178	. .	. .	. .	. .	. .	. .	173	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	527	. .
828	. .	816	. .	. .	. .	. .	. .	824	. .	. .	. .	. .	. .	. .	821	. .
. .	. .	. .	554	. .	553	. .	510	. .	554	. .	. .	. .	. .	. .	. .	557
. .	205	. .	193	. .	190	. .	210	. .	179	. .	194	. .	. .	. .	. .	200
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	098	. .
937	. .	920	. .	. .	. .	. .	. .	933	932	. .	. .	. .	. .	. .	930	932
. .	. .	. .	346	. .	362	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	363
. .	. .	. .	347	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	339
. .	. .	. .	832	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	849
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	216
309	. .	296	. .	. .	. .	319	. .	299	. .	. .	. .	. .	. .	. .	303	. .
156	. .	140	. .	. .	. .	157	. .	146	. .	. .	. .	. .	. .	. .	148	. .
. .	. .	. .	753	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	759
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	724	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	863	. .
. .	274	. .	274	. .	269	. .	285	. .	261	. .	267	*273*	267	270	. .	272

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		Pl 20 ⊙ 62 I ⊙ 31 II	Pl 12 ⊙ 42 III ⊙ 33 IV	Pl 13 ⊙ 42 III ⊙ 33 IV	Pl 14 ⊙ 33 IV	Sub-standard	⊙ M 44 II, M 29 III, M 22 IV							
						J c ⊙	R a ⊙	R a ⊙	R a ⊙		Ca J c M	Sp J c M	Fe J c M	Si J c M	Si J a M	Si J a M	Si J a M	Ba J c M
Fe	6	7	R	M	3083	. .	. .	. .	. .	. .	854	. .	. .	. .	. .	. .	. .	. .
	. .	4	. .	⊙″	3086	891	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ti	8	8	R	M	3088	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Al	20	10	R	M	3092	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Al	4	2	. .	M	3092	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	2	. .	⊙′	3094	730	. .	747	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	1	3	. .	⊙′	3095	000	. .	015	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	6	. .	M	3100	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe (Mn)	4	6	. .	M	3100	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	6	6	. .	M	3100	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ni	20	8	R	M	3101	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ni	10	6	R	M	3101	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	2	. .	⊙	3106	. .	. .	677	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Cr?	. .	3	. .	⊙′	3109	434	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	2	. .	⊙″	3115	. .	. .	170	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Va	7	5	. .	⊙″	3121	259	. .	271	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Zr	3	1	. .	⊙′	3129	879	860	887	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ni	10	8	R	M	3134	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Co	4	2	. .	⊙′	3137	439	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	3	. .	⊙′	3140	865	865	877	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	2	. .	⊙′	3153	861	863	887	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ca	. .	8	. .	M	3158	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mn	. .	1	. .	⊙′	3167	283	286	302	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	5	. .	⊙″	3172	175	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
La?	1	1	. .	⊙′	3176	096	097	120	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Cr?	4	4	. .	⊙′	3188	154	163	181	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ni	3	3	. .	M	3195	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ti	10	4	R	⊙″	3200	024	022	049	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	5	5	. .	M	3214	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ti	4	3	. .	⊙″	3218	376	385	406	395	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	6	. .	⊙′	3219	697	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	6	. .	⊙′	3219	909	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .

⊙ M 48 II, M 32 III, M 24 IV				Substandard	⊙ M 32 II												Substandard	M 32 III, M 24 IV		Mean	
Mg J c M	Si J b M	Si J c M	Ni J c M	⊙	Prd J b ⊙	Prd J b M	Ca J c ⊙	Ca J c M	Ba J b ⊙	Ba b J M	Sp J b ⊙	Sp J b M	Co J b ⊙	Co J b M	Si J b ⊙	Si J b M		C 48 J b M	Sn 48 J c M	⊙	M
..	..	851	..	..	..	..	..	841	..	..	..	..	..	..	..	..	..	..	..	..	849
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	891	..
..	..	..	..	..	..	..	..	137	..	..	..	..	..	..	..	..	..	..	..	..	187
..	816	826	..	..	..	830	..	827	..	823	..	823	..	819	..	825	*824*	827	820	..	824
..	..	949	..	..	..	975	..	970	..	955	..	971	..	952	..	..	..	..	..	..	962
..	..	..	..	*738*	737	..	729	..	..	..	751	..	739	..	741	..	..	..	..	789	..
..	..	..	..	..	006	..	998	..	..	..	002	..	010	..	992	..	..	..	..	003	..
..	..	..	..	..	..	..	..	076	..	..	..	..	..	..	..	..	..	..	..	..	064
..	..	051	..	..	..	..	..	421	..	..	..	..	..	..	..	..	..	..	..	..	415
..	..	408	..	..	..	..	..	783	..	..	..	..	..	..	..	..	..	..	..	..	779
..	..	775	..	..	..	..	..	..	..	..	..	..	..	672	..	..	..	..	..	..	678
..	..	..	673	..	..	..	..	..	..	..	..	..	..	994	..	..	..	..	..	..	994
..	..	..	993	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	677	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	434	..
..	..	..	..	..	..	..	150	..	..	..	..	..	..	..	..	..	..	..	..	160	..
..	..	..	..	*265*	273	..	267	..	299	..	278	..	276	..	..	..	..	..	..	275	..
..	..	..	..	*876*	..	..	880	..	..	..	..	..	..	..	..	..	..	..	..	882	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	223
..	..	..	223	..	..	..	443	..	..	..	..	..	..	..	..	..	..	..	..	441	..
..	..	..	..	*868*	..	..	867	..	..	..	..	..	..	..	..	..	..	..	..	869	..
..	..	..	..	*868*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	870	..
..	..	..	..	..	..	..	988	994	..	..	..	..	..	..	..	..	..	..	..	988	994
..	..	..	..	*288*	..	..	290	..	..	..	..	..	..	..	..	..	..	..	..	290	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	175	..
..	..	..	..	*102*	..	..	104	..	..	..	..	..	..	..	..	..	..	..	..	104	..
..	..	..	..	*163*	..	..	157	..	..	..	..	..	..	..	..	..	..	..	..	164	..
..	..	..	..	..	..	..	702	729	..	..	..	..	..	..	..	..	..	..	..	702	729
..	..	..	..	*030*	..	..	034	040	..	..	..	..	..	..	..	..	..	..	..	032	040
..	..	152	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	152
..	..	..	..	*390*	..	..	390	..	..	..	..	..	..	..	..	..	..	..	..	390	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	697	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	909	..

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		Pl 20 ⊙62 I ⊙31 II — J c ⊙	Pl. 13 ⊙42 III ⊙32 IV — R a ⊙	Pl. 14 ⊙32 IV — R a ⊙	Pl. 15 ⊙44 III ⊙33 IV — R a ⊙	Pl. 1 ⊙45 III ⊙34 IV — R a ⊙	Sub-standard	⊙ M 48 II, M 32 III, M 24 IV — Mg J c M	Si b J b M	Si c J c M	Ni J c M	⊙ M 32 II — Prd J b ⊙	Prd J b M	Ca J c ⊙	Ca J c M
Fe—	6	d_{7}^{5}	. .	⊙	3222	. .	. .	. .	. .	. .	. .	. .	. .	203	. .	. .	. .	203	190
Ti	6	4	. .	⊙″	3224	354	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	381	. .
Fe	8	8	. .	M	3225	. .	. .	. .	. .	. .	. .	. .	. .	898	. .	. .	. .	923	915
Ti—	5	5	. .	⊙″	3231	421	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ti	6	4	. .	M	3232	393	414	405	. .	. .	*404*	. .	. .	. .	. .	404	. .	403	. .
Ti	10	8	R	M	3236	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	697	696
—Fe	. .	6	. .	⊙″	3246	110	138	125	. .	. .	*124*	. .	. .	. .	. .	121	. .	121	. .
Cu	100	9	R	M	3247	. .	. .	. .	. .	. .	. .	. .	660	667	674	674	665	675	670
Mn, Ti, Fe	4,3,1	4	. .	⊙′	3260	373	. .	392	. .	. .	. .	. .	. .	. .	. .	389	. .	379	. .
Va	10	4	. .	⊙″	3267	850	. .	842	. .	. .	. .	. .	. .	. .	. .	836	. .	837	. .
Cu	100	6	R	⊙″	3274	. .	. .	. .	. .	. .	. .	100	066	074	083	090	098	090	089
Ti	6	5	. .	⊙″	3287	. .	. .	796	. .	. .	. .	. .	. .	. .	. .	785	. .	786	. .
Fe—(Co,Ti)	5,4,7	5	. .	⊙″	3292	. .	. .	176	176	. .	. .	. .	. .	. .	. .	171	. .	166	. .
Mn, Di	3, 2	4	. .	⊙″	3295	. .	. .	942	968	. .	. .	. .	. .	. .	. .	. .	. .	952	. .
Na	10	6	R	⊙″	3302	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	507	. .	503	498
Na	9	5	R	M	3303*	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	106	. .	109	107
—Fe	. .	d_{2}^{4}	. .	⊙′	3303	. .	. .	651	662	. .	. .	. .	. .	. .	. .	642	. .	644	. .
Fe	10	7	. .	M	3306	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	124	. .	119	119
Fe	10	7	. .	M	3306	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	477	. .	472	481
Mn—(Co,Ti)	2,3,6	d 5	. .	⊙″	3308	. .	. .	927	937	. .	. .	. .	. .	. .	. .	926	. .	925	. .
Ti	5	5	. .	⊙″	3318	. .	. .	165	167	. .	. .	. .	. .	. .	. .	165	. .	159	. .
Fe	2	3	. .	⊙′	3331	. .	. .	. .	. .	717	. .	. .	. .	. .	. .	. .	. .	746	. .
Cr—Fe	3, 3	d_{3}^{3}	. .	⊙′	3348	. .	. .	. .	013	994	. .	. .	. .	. .	. .	. .	. .	021	. .
Fe	2	2	. .	⊙′	3351	. .	. .	. .	880	860	. .	. .	. .	. .	. .	. .	. .	885	. .
Zr	4	1	. .	⊙″	3356	. .	. .	. .	. .	211	. .	. .	. .	. .	. .	. .	. .	231	. .
Ti—Ti	5, 5	d_{3}^{3}	. .	⊙″	3377‡	. .	. .	. .	670	653	*661*	. .	. .	. .	. .	. .	. .	679	. .
Fe	2	2	. .	⊙″	3389	. .	. .	. .	886	881	*883*	. .	. .	. .	. .	916	. .	894	. .
Co—Ti	10	d	R	⊙′	3405	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	294	. .	. .	. .
Fe	2	1	. .	⊙′	3406	. .	. .	. .	577	566	*571*	. .	. .	. .	. .	609	. .	583	. .
Fe	5	4	. .	⊙′	3406	. .	. .	. .	953	940	*946*	. .	. .	. .	. .	980	. .	958	. .
Fe?	. .	2	. .	⊙″	3425	. .	. .	. .	721	717	*719*	. .	. .	. .	. .	. .	. .	. .	. .
Fe	6	5	. .	M	3427§	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	20	20	R	M	3440†	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	10	10	. .	M	3441†	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .

* Red component of a double with a Zn line between. Another Zn line at about 3302.7 in the solar spectrum.
† These are part of a group of five lines.
‡ A nebulous line of B very wide comes here.
§ Red component of double, the other line being also Fe.

⊙ M 32 II								Sub-standard.	M 32 III, M 24 IV		⊙ M 36 II, M 24 III														Mean	
Ba J b ⊙	Ba J b M	Sr J b ⊙	Sr J b M	Co J b ⊙	Co J b M	Si J b ⊙	Si J b M		C 48 J b M	Sn 48 J c M	Fe ⊙	Fe M	Th ⊙	Th M	Si G c ⊙	Si G c M	Si F c ⊙	Si F c M	Ba b ⊙	Ba b M	Sr b ⊙	Sr b M	Ca C. curve ⊙	Ca C. curve M	⊙	M
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	203	197
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	368	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	923	907
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	421	. .
409	. .	396	. .	408	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	404	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	697	696
124	. .	113	. .	137	. .	127	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	124	. .
691	678	677	669	682	673	. .	681	*673*	673	675	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	680	671
382	. .	374	. .	395	. .	391	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	384	. .
841	. .	831	. .	837	. .	835	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	839	. .
091	083	080	080	107	113	. .	114	*090*	091	088	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	092	090
794	. .	790	. .	791	. .	795	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	791	. .
169	. .	175	. .	182	. .	177	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	174	. .
958	. .	965	. .	956	. .	960	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	957	. .
495	. .	494	. .	508	. .	. .	509	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	501	504
093	. .	100	. .	113	. .	. .	130	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	107	119
645	. .	646	. .	647	. .	647	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	648	. .
116	. .	114	. .	110	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	117	119
463	. .	463	. .	482	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	471	481
928	. .	921	. .	929	. .	931	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	928	. .
161	. .	157	. .	164	. .	169	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	163	. .
744	. .	743	. .	746	. .	752	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	741	. .
014	. .	007	. .	008	. .	022	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	011	. .
875	. .	874	. .	881	. .	884	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	877	. .
220	. .	219	. .	222	. .	229	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	222	. .
670	. .	663	. .	665	. .	667	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	667	. .
884	. .	886	. .	872	. .	878	. .	. .	. .	. .	892	913	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	883	. .	887	913
255	. .	270	. .	254	255	264	. .	. .	. .	. .	. .	. .	271	. .	269	. .	300	. .	268	. .	. .	. .	. .	. .	272	255
566	. .	571	. .	578	. .	. .	. .	. .	. .	. .	582	602	583	. .	580	. .	608	. .	581	. .	. .	. .	575	. .	581	602
945	. .	953	. .	946	. .	. .	. .	. .	. .	. .	952	965	955	. .	953	. .	980	. .	949	. .	. .	. .	945	. .	955	965
. .	. .	723	. .	717	. .	. .	. .	. .	. .	. .	721	. .	722	. .	720	. .	726	. .	721	. .	725	. .	716	. .	721	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	282	281	. .	. .	. .	277	. .	. .	. .	. .	. .	. .	. .	. .	282	279
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	760	760	. .	758	758	761	761	759	. .	749	. .	755	758	750	759	756
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	129	124	. .	. .	140	145	139	139	. .	134	. .	134	132	133	135	135

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		Pl 15 ⊙44 III ⊙33 IV	Pl 1 ⊙45 III ⊙34 IV	Pl 2 ⊙48 III ⊙36 IV	Sub-standard	⊙ M 36 II, M 24 III							
						R a ⊙	R a ⊙	R a ⊙		Fe J c ⊙	Fe J c M	Th J c ⊙	Th J c M	Si G J a ⊙	Si G J a M	Si G J a ⊙	Si G J a M
Fe	8	8	R	M	3444	..	..	..	..	029	029	..	..	..	..	..	..
Co	4	4	R	⊙″	3455	390	383	..	*386*	379	..	383	..	..	..	..	..
Sr?	8	3	..	⊙″	3464	613	612	..	*612*	604	..	610	..	..	..	..	..
Co–Fe	7,10	10 d	R, R	M	3466** or 5	..	..	..	..	980	010	..	017	..	..	..	..
Fe	10	10	R	M	3475††	..	..	..	..	585	597	..	605	..	..	..	..
Fe	7	8 d	R	M	3476††	..	..	..	..	830	846	..	..	..	..	..	..
Co, Fe, Ni	2,3,2	4	..	⊙″	3478 or 7	014	998	001	*004*	995	..	003	..	..	..	..	..
Ni	3	5	R	⊙′	3486	..	048	045	*046*	030	..	036	..	..	..	..	..
Fe	10	10	R	M	3490*	..	..	..	..	716	718	..	732	..	..	..	..
Co–	4	4	R	⊙″	3491	..	..	470	..	459	..	467	..	..	..	..	..
Fe	5	5	..	M	3497†	..	..	..	..	264	266	..	..	..	..	..	..
Fe–	6	d_3^7	R	M	3497‡	..	..	..	..	981	986	..	..	..	..	..	..
Fe	2	3	..	⊙″	3500	..	..	710	..	..	..	..	..	..	..	..	..
Ni	7	5	R	⊙″	3500 or 1	..	..	..	..	991	..	001	..	..	..	..	..
Ti	5	4	..	⊙′	3510‡‡	..	..	983	..	981	..	982	..	..	..	..	..
Fe	7	6	R	M	3513‡	..	..	..	..	952	986	..	..	..	..	..	..
Co	6	5	R	⊙″	3518	..	..	486	..	481	..	483	..	489	..	..	..
Th	100	..	R	M	3519	..	..	..	..	..	..	..	342	..	..	..	..
Fe	5	7	R	M	3521	..	..	..	..	398	407	401	397	408	407	405	409
Th	20	..	R	M	3529	..	..	..	..	..	..	..	547	..	..	..	..
Fe	3	5	..	⊙″	3540	..	..	266	..	261	..	261	..	261	..	..	..
Va	1	4	..	⊙″	3545	..	..	332	..	330	..	329	..	..	..	..	..
Y	..	..	..	⊙″	3549	..	..	..	..	..	..	..	..	..	..	..	..
Fe	2	3	..	⊙″	3550 or 49	..	..	013	..	..	..	998	..	..	..	..	..
Fe	9	8	R	⊙	3558	..	..	..	..	659	671	661	673	..	..	..	..
Ti–Fe	2,1	d_2^1	..	⊙″	3564	..	..	683	..	675	..	674	..	679	..	678	..
Fe	10	12	R	M	3565	..	..	..	..	523	519	526	526	..	..	..	..
Fe	20	20	R	M	3570§	..	..	..	..	223	250	217	245	..	..	..	..
Fe	10	10	..	M	3570	..	..	..	..	402	412	..	..	..	..	..	..
Fo	30	40	R	M	3581	..	..	..	..	338	340	340	344	..	339	..	340
Fe?	2	4	..	⊙″	3583	..	..	484	..	477	..	475	..	480	..	483	..
Y	..	..	..	M	3584	..	..	..	..	..	..	..	..	..	..	..	..
C	..	2	..	M	3586‖ or 5	..	..	..	..	..	029	..	984	..	..	..	..
C	..	..	..	M	3586	..	..	..	..	..	..	..	..	..	..	..	..
C	..	3	..	M	3590¶	..	..	..	..	..	556	..	500	..	..	..	..

* Co. line near this to the red.
† Red component of a double.
‡ Violet component of a double.
§ Probably several lines mixed together in solar spectrum.
‖ First line in the second head of the carbon band.
¶ First line in the first head of the carbon band.
** The metal measured was Fe.
†† Strongest line of group.
‡‡ A strong compound Bi line comes here also.

⊙ M 36 II, M 24 III												⊙ M 37 III		⊙ M 38 II		Mean	
Si G J c ⊙	Si G J c M	Si F J a ⊙	Si F J a M	Si F J c ⊙	Si F J c M	Ba J c ⊙	Ba J c M	Sr J c ⊙	Sr J c M	Ca J c ⊙	Ca J c M	Ca J c ⊙	Ca J c M	Ni J c ⊙	Ni J c M	⊙	M
039	034	. .	. .	034	028	. .	014	. .	015	025	023	. .	. .	. .	. .	032	024
385	. .	. .	. .	382	. .	383	. .	394	. .	378	. .	. .	. .	. .	. .	384	. .
610	. .	. .	. .	608	. .	606	. .	. .	. .	609	. .	. .	. .	. .	. .	609	. .
012	018	. .	. .	. .	009	. .	004	. .	004	982	008	. .	. .	. .	. .	991	010
600	611	. .	. .	. .	599	. .	594	. .	608	598	601	. .	. .	. .	. .	594	602
831	861	. .	. .	. .	856	. .	845	. .	834	. .	. .	. .	. .	. .	. .	831	848
002	. .	. .	. .	001	. .	999	. .	993	. .	001	. .	. .	. .	. .	. .	001	. .
036	. .	. .	. .	036	. .	029	. .	029	. .	039	. .	. .	. .	. .	. .	036	. .
726	728	. .	. .	. .	726	. .	718	. .	719	721	726	. .	. .	. .	. .	721	724
466	. .	. .	. .	462	. .	453	. .	469	. .	469	. .	. .	. .	. .	. .	464	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	264	266
998	999	. .	. .	992	. .	. .	994	. .	985	992	993	. .	. .	. .	. .	991	991
. .	. .	. .	. .	712	. .	. .	. .	711	. .	713	. .	. .	. .	. .	. .	712	. .
002	. .	. .	. .	997	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	993	. .
992	. .	. .	. .	988	. .	992	. .	988	. .	992	. .	. .	. .	. .	. .	987	. .
966	976	. .	. .	. .	. .	. .	. .	924	. .	. .	. .	. .	. .	. .	. .	947	981
493	. .	484	. .	489	. .	489	. .	487	. .	493	. .	. .	. .	. .	. .	487	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	342
408	416	. .	. .	. .	. .	. .	420	. .	. .	. .	. .	. .	. .	. .	. .	404	409
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	547
262	. .	262	. .	270	. .	272	. .	277	. .	263	. .	. .	. .	. .	. .	266	. .
334	. .	. .	. .	339	. .	. .	. .	. .	. .	335	. .	. .	. .	. .	. .	333	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	145	147	. .	. .	145	147
007	. .	. .	. .	013	. .	010	. .	. .	. .	002	. .	998	. .	. .	. .	006	. .
671	679	. .	. .	687	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	670	674
681	. .	682	. .	687	. .	687	. .	682	. .	685	. .	664	. .	. .	. .	680	. .
532	535	. .	. .	. .	. .	. .	542	. .	529	532	530	. .	. .	. .	. .	528	530
227	254	. .	. .	. .	260	. .	265	. .	255	234	250	. .	241	. .	. .	225	253
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	402	412
344	348	. .	342	352	. .	. .	. .	. .	348	343	346	346	345	. .	. .	344	344
485	. .	482	. .	487	. .	489	. .	488	. .	479	. .	481	. .	. .	. .	483	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	662	662	. .	. .	662	662
. .	974	. .	. .	. .	008	. .	981	. .	983	. .	000	. .	973	. .	. .	. .	992
. .	049	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	033	. .	. .	. .	041
. .	544	. .	. .	. .	540	. .	. .	. .	504	. .	512	. .	507	. .	. .	. .	523

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		Pl 2 ⊙ 48 III ⊙ 36 IV	Pl 3 ⊙ 49 III ⊙ 37 IV	Pl 4 ⊙ 50 III ⊙ 38 IV	Substandard	⊙ M 36 II, M 24 III							
						R a ⊙	R a ⊙	R a ⊙	⊙	Fe J c ⊙	Fe J c M	Th J c ⊙	Th J c M	Si G J a ⊙	Si G J a M	Si G J a ⊙	Si G J a M
Fe	5	4	. .	⊙″	3597	190	. .	. .	. .	188	. .	188	. .	189	. .	191	. .
Ytt	10	4	. .	⊙″ M	3600	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ytt	6	3	. .	⊙	3602	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Cr	20	3	R	M	3605†	. .	. .	. .	. .	478	. .	. .	. .	. .	. .	. .	. .
Fe	7	7	. .	M	3605†	. .	. .	. .	. .	626	623	. .	. .	. .	. .	. .	. .
Fe	7	6?	. .	M	3606‡	. .	. .	. .	. .	829	832	. .	. .	. .	. .	. .	. .
Fe	15	15	R	M	3609	. .	. .	. .	. .	009	009	012	013	016	011	016	011
Ytt	7	3	. .	M	3611	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	4	. .	⊙′	3612	216	217	. .	*216*	210	237	216	. .	217	. .	216	. .
Ca – Fe	4	d^2_3	. .	M	3617§	. .	. .	. .	. .	920	939	. .	. .	. .	. .	. .	. .
Fe	20	20	R	M	3618	. .	. .	. .	. .	918	917	918	918	925	918	923	920
Ytt	3	1	. .	M	3621	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	4	. .	⊙	3621	. .	. .	. .	. .	599	613	. .	. .	. .	. .	. .	. .
Fe	4	4	. .	⊙ M	3622	. .	. .	. .	. .	143	156	. .	. .	. .	. .	. .	. .
Fe	4	4	. .	⊙″	3623	330	331	. .	*330*	320	338	330	. .	332	. .	336	. .
Fe	2	3 d?	. .	⊙″	3623	599	608	. .	*604*	595	. .	597	. .	. .	. .	. .	. .
Ytt	3	2	. .	M	3628	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	20	20	R	M	3631	. .	. .	. .	. .	613	611	615	612	622	615	620	612
Ytt	5	d	. .	M	3633‖	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ti	10	3	R	⊙′	3635	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	4	. .	M	3638	. .	. .	. .	. .	435	454	. .	. .	. .	. .	. .	. .
Pb	50	1	R	M	3639*	. .	. .	. .	. .	. .	. .	. .	726	. .	725	.	727
Cr – Fe	2,5	d^1_4	. .	⊙′	3640§	536	534	. .	*535*	533	545	537	. .	534	. .	535	. .
Fe	10	10	R	M	3647	. .	. .	. .	. .	993	989	994	994	992	986	993	989
Co	8	3	R	⊙″	3652	689	693	. .	*691*	. .	. .	. .	. .	. .	. .	. .	. .
Ti	10	4	R	⊙	3653	. .	. .	. .	. .	642	. .	636	. .	634	. .	639	. .
Mn – Fe	2,2	1,2	. .	⊙″	3658	. .	684	. .	. .	686	. .	. .	. .	. .	. .	. .	. .
Fe	5	3	. .	⊙″	3667	400	398	. .	. .	395	. .	391	. .	395	. .	393	. .
Fe	7	7	R	M	3680	. .	. .	. .	. .	063	066	. .	. .	063	061	061	059
Co, Fe, Va	9,3,4	6	. .	⊙″	3683§	. .	200	197	. .	203	209	203	. .	198	. .	200	. .
Pb	60	½	R	M	3683	. .	. .	. .	. .	. .	628	. .	619	. .	617	. .	621
Fe	5	6	. .	⊙″	3684	. .	256	255	. .	260	268	258	. .	257	. .	258	. .
Fe	10	8	R	M	3687	. .	. .	. .	. .	606	607	. .	. .	603	602	605	606
Fe	5	5	. .	⊙″	3695	. .	197	192	. .	194	208	194	. .	. .	. .	. .	. .

* In solar spectrum this is the red component of a double, the other being Co.

† Solar line is a group of four lines, the extreme line to red being Fe.

‡ Red component of an equal double.

§ Metal measured was Fe.

‖ Red component of double.

⊙ M 36 II, M 24 III												⊙ M 37 III		⊙ M 38 II		Mean	
Si G J c ⊙	Si G J c M	Si F J a ⊙	Si F J a M	Si F J c ⊙	Si F J c M	Ba J c ⊙	Ba J c M	Sr J c ⊙	Sr J c M	Ca J c ⊙	Ca J c M	Ca J c ⊙	Ca J c M	Ni J c ⊙	Ni J c M	⊙	M
194	. .	190	. .	195	. .	201	. .	193	. .	. .	. .	191	. .	196	. .	192	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	880	884	. .	. .	880	884
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	061	065	. .	. .	061	065
487	497	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	483	497
643	618	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	635	621
832	839	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	831	836
013	018	015	012	019	022	028	024	. .	015	014	018	012	012	. .	. .	015	015
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	193	196	. .	. .	193	196
218	. .	216	. .	220	. .	223	. .	221	. .	214	. .	210	. .	219	. .	217	287
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	920	939
926	923	923	921	930	931	936	931	. .	922	922	920	923	921	. .	. .	924	922
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	122	096	. .	. .	122	096
612	619	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	606	616
151	165	. .	. .	149	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	147	161
331	. .	332	. .	336	. .	335	. .	335	. .	331	. .	336	. .	332	. .	332	338
600	. .	. .	. .	603	. .	612	. .	602	. .	. .	. .	600	. .	599	. .	603	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	853	853	. .	. .	853	858
625	621	616	614	625	627	624	626	. .	618	615	612	610	613	. .	. .	619	616
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	259	277	. .	. .	259	277
. .	. .	. .	. .	. .	. .	. .	609	. .	617	. .	. .	616	618	. .	. .	616	615
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	435	454
. .	732	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	728
537	. .	540	. .	545	. .	538	. .	535	. .	534	. .	543	. .	531	. .	536	545
983	990	995	992	005	007	010	007	993	994	994	. .	991	997	. .	. .	995	995
. .	. .	. .	. .	. .	. .	. .	. .	688	. .	690	. .	698	. .	. .	. .	692	. .
635	. .	644	. .	. .	. .	. .	. .	. .	636	640	642	. .	. .	. .	. .	639	639
687	. .	. .	. .	701	. .	. .	. .	685	. .	689	. .	. .	. .	681	. .	688	. .
392	. .	398	. .	414	. .	. .	. .	395	. .	397	. .	407	. .	389	. .	397	. .
062	064	066	059	073	074	. .	. .	. .	060	058	062	. .	. .	. .	. .	064	064
202	. .	204	. .	212	. .	198	. .	. .	. .	203	. .	215	. .	197	. .	202	209
. .	624	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	622
261	. .	259	. .	269	. .	258	. .	259	. .	259	. .	263	. .	257	. .	259	268
604	609	. .	. .	618	618	. .	615	. .	600	605	605	. .	. .	. .	. .	607	609
193	. .	. .	. .	195	. .	191	. .	194	. .	195	. .	202	. .	189	. .	194	208

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		Pl 3 ⊙ 49 III ⊙ 37 IV	Pl 4 ⊙ 50 III ⊙ 38 IV	Pl 5 ⊙ 52 III ⊙ 39 IV	Pl 6 ⊙ 52 III ⊙ 39 IV	⊙ M 40 II, M 27 III				Sub-Standard.	⊙ M 36 II, M 24 III			
						R a ⊙	R a ⊙	R a ⊙	R a ⊙	Co J C ⊙	Co J C M	Zr J C ⊙	Zr J C M		Fe J C ⊙	Fe J C M	Th J C ⊙	Th J C M
Fe	7	8	R	M	3705§	. .	. .	. .	. .	. .	. .	. .	. .	. .	709	714	711	715
Fe	. .	5	. .	⊙′	3707	182	181	. .	. .	. .	. .	. .	. .	. .	186	201	187	. .
Fe	10	10	R	M	3709	. .	. .	. .	. .	. .	. .	. .	. .	. .	394	393	395	399
Y	. .	. .	. .	M	3710	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	6	7	. .	⊙″	3716	581	575	. .	. .	. .	. .	. .	. .	. .	586	601	586	. .
Fe	50	50	R	M	3720	. .	. .	. .	. .	. .	. .	. .	. .	. .	088	082	083	081
Ni – Fe, Ti	4,8,5	d 10	. .	M	3722*	. .	. .	. .	. .	. .	. .	. .	. .	. .	692	713	687	710
Fe	6	7	R	M	3727	. .	. .	. .	. .	. .	. .	. .	. .	. .	759	766	765	765
Fe	5	5	. .	⊙″	3732	550	536	. .	. .	. .	. .	. .	. .	. .	540	549	541	. .
Fe	6	7	R	M	3733	. .	. .	. .	. .	. .	. .	. .	. .	. .	466	471	466	470
Fe	50	60	R	M	3735	. .	. .	. .	. .	. .	. .	. .	. .	. .	014	013	012	009
Ni	6	. .	. .	⊙	3736	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ca, Mn	4,2	8	R	M	3737	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	25	30	R	M	3737	. .	. .	. .	. .	. .	. .	. .	. .	. .	102	095	. .	. .
Ti, Fe, Cr	3,5,3	t 2,6,2	. .	M	3743‖	. .	. .	. .	. .	. .	. .	. .	. .	. .	284	276	282	277
Fe	8	10	R	M	3745†	. .	. .	. .	. .	. .	. .	. .	. .	. .	496	499	. .	. .
Fe	6	7	R	M	3746	. .	. .	. .	. .	. .	. .	. .	. .	. .	697	697	693	706
Fe –	3	d 7	. .	⊙′	3747*	. .	. .	. .	. .	. .	. .	. .	. .	. .	052	044	050	046
Fe	9	10	R	M	3748	. .	. .	. .	. .	. .	. .	. .	. .	. .	092	082	094	. .
Fe	15	20	R	M	3749	. .	. .	. .	. .	. .	. .	. .	. .	. .	408	407	408	408
	. .	d 2,1	. .	⊙	3754	661	651	. .	. .	. .	. .	. .	. .	. .	631	629	631	632
Fe	2	2	. .	⊙′	3756	210	207	. .	. .	. .	. .	. .	. .	. .	661	. .	665	. .
Fe	10	15	R	M	3758	. .	. .	. .	. .	. .	. .	. .	. .	. .	211	. .	213	. .
Fe	9	10	R	M	3763	. .	. .	. .	. .	. .	. .	. .	. .	. .	377	376	380	383
Fe	7	8	R	M	3767	. .	. .	. .	. .	951	947	. .	. .	. .	936	934	939	936
Fe	3	d 4	. .	⊙	3770	118	124	. .	. .	351	352	. .	. .	. .	339	338	341	342
Y	. .	. .	. .	M	3774	. .	. .	. .	. .	138	. .	. .	. .	. .	131	. .	134	. .
Th	100	. .	R	M	3775	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
	. .	4	. .	⊙′	3780	847	851	836	. .	. .	. .	. .	. .	. .	. .	. .	. .	869
Fe	. .	3	. .	⊙′	3781	333	330	324	. .	848	. .	850	. .	*847*	846	. .	846	. .
Ni	10	6	R	⊙	3783	676	680	673	. .	333	. .	337	. .	*332*	328	. .	332	. .
Fe	7	8	R	⊙	3788	. .	. .	. .	. .	676	. .	681	. .	*677*	668	. .	674	. .
Fe, Cr	1.1	3	. .	⊙	3794	021	024	010	. .	. .	. .	. .	. .	. .	030	025	029	027
Fe	8	8	. .	M	3795‡	. .	. .	. .	. .	013	. .	013	. .	*017*	012	. .	012	. .
									. .	151	. .	150	146	. .	146	154	151	143

* The metallic line measured was Fe.

† Solar line mixed. Co line near to violet.

‡ V line very near to violet.

§ Violet component of double.

‖ Metal measured was Fe.

⊙ M 36 II, M 24 III																⊙ M 37 III		⊙ M 38 II		Mean	
Si G J a ⊙	Si G J a M	Si G J a ⊙	Si G J a M	Si G J c ⊙	Si G J c M	Si F J a ⊙	Si F J a M	Si F J c ⊙	Si F J c M	Ba J c ⊙	Ba J c M	Sp J c ⊙	Sp J c M	Ca J c M	Ca J c M	Ca J c ⊙	Ca J c M	Ni J c ⊙	Ni J c M	⊙	M
. .	. .	. .	. .	711	723	. .	. .	720	723	. .	723	. .	702	706	708	. .	. .	. .	. .	711	715
187	. .	. .	. .	190	. .	187	. .	196	. .	180	. .	184	. .	184	. .	195	. .	182	. .	186	201
. .	. .	. .	. .	399	400	. .	. .	401	403	. .	389	. .	388	. .	. .	. .	. .	. .	. .	397	395
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	438	442	. .	. .	438	442
. .	. .	. .	. .	587	. .	. .	. .	594	. .	581	. .	583	. .	582	. .	594	. .	583	. .	585	601
091	084	087	082	088	085	081	080	090	093	080	079	. .	072	084	081	084	086	. .	. .	086	082
. .	. .	. .	. .	694	712	. .	. .	698	722	. .	715	. .	706	684	707	. .	. .	. .	. .	691	712
. .	. .	. .	. .	766	769	. .	. .	. .	. .	. .	774	. .	767	. .	. .	. .	. .	. .	. .	768	768
544	. .	. .	. .	546	. .	539	. .	547	. .	536	. .	536	. .	539	. .	549	. .	538	. .	542	549
. .	. .	. .	. .	469	469	. .	. .	. .	. .	. .	468	. .	458	. .	. .	. .	. .	. .	. .	467	467
. .	. .	. .	. .	012	016	. .	. .	018	017	013	011	. .	002	017	013	014	017	. .	. .	014	012
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	977	. .	961	. .	. .	. .	969	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	056	. .	069	067	. .	. .	075	081
. .	. .	. .	. .	285	283	. .	. .	285	286	279	275	. .	275	279	284	279	281	. .	. .	282	280
. .	. .	. .	. .	508	513	. .	. .	. .	. .	. .	509	. .	502	. .	. .	. .	. .	. .	. .	502	506
. .	. .	. .	. .	702	717	. .	. .	699	712	. .	710	. .	704	699	709	718	712	. .	. .	701	708
. .	. .	. .	. .	056	053	. .	. .	059	056	. .	044	. .	. .	054	047	. .	. .	. .	. .	054	048
. .	. .	. .	. .	095	. .	. .	. .	099	. .	088	. .	091	. .	096	. .	105	. .	094	. .	095	082
. .	. .	. .	. .	412	419	. .	. .	415	415	398	405	. .	403	407	411	415	409	. .	. .	409	410
. .	. .	. .	. .	636	640	. .	. .	636	638	628	634	. .	623	629	628	637	637	. .	. .	633	638
. .	. .	. .	. .	670	. .	. .	. .	673	. .	661	. .	660	. .	666	. .	672	. .	666	. .	664	. .
. .	. .	. .	. .	216	. .	. .	. .	216	. .	203	. .	209	. .	211	. .	217	. .	208	. .	211	. .
. .	. .	. .	. .	382	384	. .	. .	383	390	375	379	. .	373	377	371	381	385	. .	. .	379	380
. .	. .	. .	. .	944	947	. .	. .	940	942	939	940	. .	934	937	936	952	938	. .	. .	942	939
. .	. .	. .	. .	348	350	. .	. .	345	345	338	341	. .	333	339	334	347	339	. .	. .	344	342
. .	. .	. .	. .	135	. .	. .	. .	135	. .	127	. .	126	. .	128	. .	134	. .	128	. .	130	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	480	478	. .	. .	480	478
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	869
. .	. .	. .	. .	847	. .	. .	. .	848	. .	846	. .	847	. .	845	. .	843	. .	844	. .	846	. .
. .	. .	. .	. .	336	. .	. .	. .	331	. .	329	. .	332	. .	327	. .	329	. .	325	. .	330	. .
. .	. .	. .	. .	675	. .	. .	. .	670	. .	670	. .	675	. .	670	. .	678	. .	669	. .	674	. .
. .	. .	. .	. .	037	035	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	032	029
. .	. .	. .	. .	015	. .	. .	. .	014	. .	009	. .	015	. .	010	. .	017	. .	014	. .	014	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	150	148

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		Pl 3 ⊙49 III ⊙37 IV R a ⊙	Pl 4 ⊙50 III ⊙38 IV R a ⊙	Pl 5 ⊙52 III ⊙39 IV R a ⊙	Pl 6 ⊙52 III ⊙39 IV R a ⊙	Pl 8 ⊙55 III ⊙41 IV R a ⊙	Pl 16 ⊙59 II ⊙39 III R a ⊙	Pl 17 ⊙59 II ⊙39 III R a ⊙	Pl 17 ⊙59 II ⊙39 III R a ⊙	Pl 18 ⊙59 II ⊙39 III R a ⊙	Sub-standard ⊙
Fe	. .	7	. .	⊙	3798	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	8	. .	⊙	3799	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	2	3	. .	⊙″	3804	154	155	147	. .	. .	. .	. .	. .	. .	. .
Fe, Di	4	6	. .	⊙″	3805	495	497	488	. .	. .	. .	. .	. .	. .	. .
Fe	15	20	R	M	3815	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	20	25	R	M	3820	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	5	6	. .	⊙′	3821	. .	328	311	312	. .	. .	. .	. .	. .	. .
Mn, Cr	5,1	5	R	⊙′	3823	. .	656	662	646	. .	. .	. .	. .	. .	. .
Fe	15	20	R	M	3826	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	8	8	R	M	3827	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mg	5	8	R	. .	3829	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mg	8	10	R	. .	3832	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
C	. .	5	. .	⊙	3836	. .	237	225	228	. .	. .	. .	. .	. .	. .
C	. .	6	. .	M	3836†	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mg	50	20	R	⊙	3838	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	7	7	R	M	3840	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	5	. .	⊙	3843	. .	406	391	400	. .	. .	. .	. .	. .	. .
Fe	6	7	. .	⊙	3856	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	10	10	R	M	3860	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
C	. .	3	. .	⊙′	3864‡	. .	. .	. .	. .	. .	448	440	453	. .	. .
C	. .	7	. .	M	3871§	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
– V	6	3	. .	⊙	3875	. .	200	218	269	. .	234	234	236	232	*231*
C	. .	7	. .	M	3883‖	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
C	. .	. .	. .	M	3883¶	. .	. .	532	543	. .	564	565	544	570	*549*
Cr	. .	1	. .	⊙	3883	. .	. .	771	774	. .	780	784	784	778	*776*
Fe	15	9	R	. .	3886	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	. .	4	. .	. .	3897	. .	. .	594	591	. .	608	604	609	599	*598*
Si	10	8	. .	M	3905	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	3	3	. .	⊙′	3916	. .	. .	863	865	. .	886	877	888	884	*874*
Ti	6	4	. .	⊙′	3924	. .	. .	656	665	. .	677	676	684	666	*668*
Co, Fe	1,2	4	. .	⊙′	3925	. .	. .	338	342	. .	351	348	360	340	*345*
Fe	3	4	. .	⊙	3925*	. .	. .	783	782	. .	801	798	800	792	*791*
Fe –	5	d 4,4	. .	⊙′	3926*	. .	. .	116	119	. .	134	127	132	121	*123*
Fe	10	8	R	M	3928	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ca	75	300	R	M	3933	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	3	4	. .	⊙′	3937	. .	. .	466	476	459	. .	. .	484	. .	. .
Fe, Co	4,4	5	. .	⊙	3941	. .	. .	015	022	010	034	032	032	031	*024*

* .087 apart.

† Central line of symmetrical group in carbon band.

‡ One of the lines of the carbon band.

§ Second head of carbon band.

‖ First line of first head of carbon band.

¶ Edge of first head of carbon band.

⊙ M 40 II, M 27 III															Sub-standard.	⊙ M 36 II, M 24 III							⊙ M 37 III		M 38 II		Mean	
Ca J c ⊙	Ca J c M	Ca M b ⊙	Co J c ⊙	Co J c M	Zr J c ⊙	Zr J c M	Ba J b ⊙	Ba J b M	Sr J b ⊙	Sr J b M	Si D J a ⊙	Si D J a M	Si E J a ⊙	Si E J a M	⊙	Fe J c ⊙	Si G J a ⊙	Si F J c ⊙	Ba J c ⊙	Sr J c ⊙	Ca J c ⊙	Ca J c M	Ca J c ⊙	Ca J c M	Ni J c ⊙	Ni J c M	⊙	M
. .	. .	. .	659	. .	664	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	662	. .
. .	. .	. .	698	. .	697	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	698	. .
. .	. .	. .	149	. .	159	. .	. .	. .	. .	. .	. .	. .	. .	. .	*153*	152	156	153	156	156	155	. .	149	. .	155	. .	153	. .
. .	. .	. .	482	. .	490	. .	471	. .	. .	. .	. .	. .	. .	. .	*487*	485	486	485	490	485	486	. .	484	. .	489	. .	487	. .
. .	. .	. .	978	979	988	999	. .	967	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	988	990	. .	. .	. .	. .	985	984
. .	. .	. .	562	562	575	578	561	557	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	571	567	. .	. .	. .	. .	567	566
. .	. .	. .	318	. .	321	. .	307	. .	. .	. .	. .	. .	. .	. .	*316*	. .	. .	. .	. .	. .	321	. .	320	. .	327	. .	318	. .
. .	. .	. .	647	. .	650	. .	636	. .	. .	. .	. .	. .	. .	. .	*650*	. .	. .	. .	. .	. .	652	. .	653	. .	656	. .	651	. .
. .	. .	. .	024	023	030	029	013	015	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	029	029	. .	. .	. .	. .	024	024
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	973	973	. .	. .	. .	. .	973	973
. .	. .	. .	501	. .	509	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	[illegible]	. .
. .	. .	. .	444	. .	447	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	446	. .
215	. .	. .	223	. .	230	. .	212	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	237	. .	220	. .
652	638	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	652	638
. .	. .	. .	423	. .	436	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	430	. .
. .	. .	. .	583	589	584	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	584	589
388	. .	. .	392	. .	400	. .	386	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	406	. .	406	. .
. .	. .	. .	517	520	513	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	515	520
. .	. .	. .	051	057	053	. .	041	043	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	048	050
432	. .	. .	436	. .	442	. .	426	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	449	. .	441	. .
513	521	. .	522	520	. .	536	529	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	539	539	528	527
208	. .	. .	213	. .	217	. .	213	. .	. .	. .	221	. .	215	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	225	. .	224	. .
460	502	. .	476	482	. .	485	480	479	. .	447	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	472	479
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	521	523	548	523
766	. .	. .	768	. .	767	. .	758	. .	762	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	778	. .	773	. .
424	423	. .	424	422	428	426	425	419	. .	406	432	431	429	423	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	427	421
. .	. .	. .	596	. .	600	. .	590	. .	. .	. .	600	. .	595	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	601	. .	599	. .
662	669	. .	664	. .	668	672	668	678	. .	659	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	666	670
877	886	. .	872	. .	. .	. .	874	. .	858	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	875	. .	875	880
669	. .	661	671	. .	667	. .	673	. .	658	. .	673	. .	667	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	665	. .	669	. .
345	. .	344	341	. .	343	. .	352	. .	338	. .	344	. .	344	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	343	. .	345	. .
789	. .	786	787	. .	789	. .	796	. .	. .	. .	. .	. .	. .	809	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	785	. .	792	. .
121	. .	118	120	. .	120	. .	129	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	121	. .	123	. .
. .	. .	066	. .	. .	. .	. .	076	068	. .	051	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	071	060
815	808	785	820	807	808	807	. .	822	. .	798	819	809	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	809	809
481	. .	. .	476	. .	478	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	474	. .	474	. .
027	. .	. .	026	034	023	. .	. .	. .	022	. .	026	. .	027	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	024	. .	021	034

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard	*	P	E	Pl 5 ⊙ 52 III ⊙ 39 IV	Pl 6 ⊙ 52 III ⊙ 39 IV	Pl 8 ⊙ 55 III ⊙ 41 IV	Pl 9 ⊙ 55 III ⊙ 41 IV	Pl 16 ⊙ 59 II ⊙ 39 III	Pl 17 ⊙ 59 II ⊙ 39 III	Pl 17 ⊙ 59 II ⊙ 39 III	Pl 18 ⊙ 59 II ⊙ 39 III
								R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙
−Fe	5	d 3,4	. .	⊙	3942*	. .	. .	545	547	550	. .	567	560	557	550
Al	20	10	R	M	3944	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ca	4	2	. .	M	3949†	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	4	. .	⊙″	3950	. .	. .	081	092	092	. .	108	112	111	104
Y	10	2	. .	⊙	3950	. .	. .	480	488	489	. .	504	504	502	505
Fe	2	2	. .	⊙′	3953 or 4	. .	. .	983	001	996	. .	002	008	000	992
Fe, Ca	5,6	6	. .	⊙′	3957	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	3	3	. .	⊙″	3960	. .	. .	408	452	416	. .	. .	. .	431	. .
Al	15	15	R	M	3961	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ca	70	200	R	M	3968	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
H	. .	. .	. .	. .	3970.05°	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	5	4	. .	⊙′	3971‡	. .	. .	457	463	468	. .	488	491	479	491
Ca	5	3	. .	M	3973	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	5	4	. .	⊙″	3977	. .	. .	. .	873	880	. .	891	897	898	890
Fe, Ti	6	4	. .	⊙	3981	. .	. .	. .	890	906	. .	. .	. .	921	. .
Cr, Fe	5,3	d 6	. .	⊙	3984§	. .	. .	. .	061	062	. .	. .	. .	091	. .
−Mn	4	d 7	. .	⊙	3986	. .	. .	. .	886	888	. .	. .	. .	. .	. .
−Mn, Co	4,2	t 7	. .	⊙	3987	. .	. .	. .	199	205	. .	. .	. .	. .	. .
Co, Fe, Ti	4,1,2	3	. .	⊙	4003	. .	. .	. .	892	912	. .	. .	. .	. .	. .
Fe +	. .	10	. .	⊙	4005‖	. .	. .	312	290	314	. .	. .	. .	. .	. .
Fe	. .	3	. .	⊙″	4016	. .	. .	. .	. .	575	. .	. .	. .	. .	. .
Fe, Zr	2,2	4	. .	⊙″	4029	. .	. .	. .	792	798	. .	. .	. .	. .	. .
Mn	50	6	R	M	4030¶	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mn	40	5	R	M	4033**	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mn	30	4	R	M	4034††	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mn	5	2	. .	M	4035.9††	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
K	50	1	R	M	4044	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	20	15	R	M	4045	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
K	40	½?	R	M	4047	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Zr, Mn, Cr	1,8,2	t	. .	⊙	4048	. .	894	. .	880	890	. .	. .	. .	. .	. .
Mn	8	5	. .	⊙″	4055	. .	698	. .	693	705	. .	. .	. .	. .	. .
Fe	5	5	. .	⊙″	4062	. .	. .	. .	600	611	. .	. .	. .	. .	. .
Fe	20	12	R	M	4063	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	15	10	. .	⊙	4071	901	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	4	4	. .	⊙″	4073	884	909	. .	. .	931	937	. .	. .	. .	. .
Sr	100	8	R	⊙	4077	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .

* Component .085, apart.
† Red component of a triple.
‡ Components about .06 apart.
§ Red component of a double.
‖ Seven lines, mostly Fe.
¶ Violet component of double.
** Violet component of double.
†† Red component of double.
° Value determined by Dr. Ames.

Sub-standard	⊙ M 40 II															⊙ M 38 II		Mean	
	Ca J c ⊙	Ca J c M	Ca M b ⊙	Co J c ⊙	Co J c M	Zr J c ⊙	Zr J c M	Ba J c ⊙	Ba J c M	Sr J c ⊙	Sr J c M	Si D J a ⊙	Si D J a M	Si E J a ⊙	Si E J a M	Ni J a ⊙	Ni J a M	⊙	M
553	568	. .	566	567	. .	560	. .	. .	. .	559	. .	564	. .	565	. .	559	. .	559	. .
. .	157	163	145	159	167	155	154	172	180	. .	164	158	162	161	164	. .	. .	159	165
. .	047	070	020	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	034	070
098	100	. .	. .	098	. .	100	. .	113	. .	103	. .	102	. .	102	. .	101	. .	101	. .
495	496	. .	. .	496	. .	495	. .	508	. .	496	. .	. .	. .	. .	. .	496	. .	497	. .
998	001	. .	. .	002	. .	003	. .	018	. .	001	. .	. .	. .	. .	. .	003	. .	001	. .
. .	179	228	180	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	180	228*
. .	428	. .	430	427	. .	425	. .	441	. .	430	. .	. .	. .	. .	. .	428	. .	429	. .
. .	674	676	671	686	684	672	675	686	696	. .	674	677	679	675	677	469	. .	676	680
. .	626	621	612	622	615	610	610	. .	625	. .	603	631	625	. .	623	. .	. .	620	617
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
475	476	. .	478	. .	. .	. .	. .	484	. .	484	. .	. .	. .	. .	. .	. .	. .	478	. .
. .	831	881	839	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	835	881
885	890	. .	. .	891	. .	887	. .	904	. .	890	. .	897	. .	893	. .	. .	. .	891	. .
. .	918	. .	. .	916	. .	913	. .	930	. .	917	. .	. .	. .	. .	. .	919	. .	914	. .
. .	085	. .	. .	082	. .	075	. .	. .	. .	. .	. .	. .	. .	. .	. .	087	. .	078	. .
. .	. .	. .	927	909	. .	902	. .	. .	. .	. .	. .	. .	. .	. .	. .	905	. .	903	. .
. .	. .	. .	234	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	224	. .	216	. .
. .	920	. .	924	919	. .	912	. .	931	. .	921	. .	. .	. .	. .	. .	916	. .	916	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	305	. .
. .	576	. .	. .	574	. .	568	. .	592	. .	580	. .	. .	. .	. .	. .	. .	. .	578	. .
. .	798	. .	. .	796	. .	788	. .	807	. .	. .	. .	795	. .	794	. .	. .	. .	796	. .
. .	916	916	. .	912	. .	902	. .	924	924	. .	918	. .	. .	. .	. .	. .	. .	914	919
. .	227	225	. .	223	. .	215	. .	233	233	. .	232	. .	. .	. .	. .	. .	. .	225	230
. .	643	647	. .	641	. .	634	633	647	651	. .	637	. .	. .	. .	. .	. .	. .	641	642
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
. .	. .	. .	. .	295	305	291	297	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	293	301
. .	982	983	971	969	969	966	964	989	986	. .	979	970	972	975	974	. .	. .	975	975
. .	. .	. .	. .	. .	374	. .	372	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	373
. .	900	. .	893	894	. .	888	. .	905	. .	898	. .	887	. .	894	. .	. .	. .	893	. .
. .	705	. .	705	700	. .	694	. .	708	. .	705	. .	698	. .	700	. .	. .	. .	701	. .
. .	604	. .	604	598	. .	596	. .	. .	. .	603	. .	. .	. .	. .	. .	. .	. .	602	. .
. .	758	748	754	752	750	747	747	768	766	. .	759	758	762	754	752	. .	. .	756	755
. .	905	909	907	901	899	897	894	913	906	. .	900	905	908	901	903	. .	. .	904	903
. .	926	. .	933	915	. .	914	. .	930	. .	917	. .	923	. .	920	. .	. .	. .	920	. .
. .	882	881	895	876	867	876	860	888	888	883	882	. .	. .	. .	. .	. .	. .	883	876

* Ca line measured.

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St	St	P	E	Pl 6 ⊙52 III ⊙39 IV	Pl 8 ⊙55 III ⊙41 IV	Pl 9 ⊙55 III ⊙41 IV	Pl 10 ⊙57 III ⊙43 IV	Pl 12 ⊙42 III ⊙32 IV	Pl 13 ⊙42 III ⊙32 IV	⊙ M 44 II, M 29 III, M 22 IV					
						⊙	⊙	⊙	⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	Ba J c ⊙	Ba J c M	Ca J c ⊙	Ca J c M	Sr J c ⊙	Sr J c M
Fe, Mn	2,5	3,2	..	⊙	4083	..	..	792	..	753	766	759	..	..	..	..	..	..	..	..	..
Fe	2	2	..	⊙	4083	..	..	..	..	926	938	932	..	..	..	..	..	..	..	..	..
Fe	2	2	..	⊙″	4088	..	..	..	..	714	716	716	..	..	..	..	..	..	..	..	..
Si, Mn	3,1	4	..	⊙″	4103	..	..	..	..	099	107	104	..	..	..	..	..	..	..	..	..
Fe	5	4 d ?	..	⊙″	4107	..	..	629	646	635	653	654	..	..	..	..	..	..	..	..	..
Fe	3	4	..	⊙″	4114	..	..	554	598	600	608	609	..	..	..	..	..	..	..	..	..
Cr, Co	1,10	1,3	R	⊙	4121‡	..	..	..	..	471	491	487	..	..	..	..	..	..	..	..	..
Fe, Cr	3,1	3	..	⊙′	4121	..	969	..	..	960	980	970	..	..	..	..	..	..	..	..	..
Fe	4	3	..	⊙″	4157	..	945	952	..	948	..	955	..	941	942	..	..	..	..	..	..
C	..	..	..	M	4158.2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fe	4	3	..	⊙″	4185	..	067	028	053	..	..	079	..	077	074	..	..	065	..	..	..
C	..	1	..	⊙	4197*	..	..	..	..	..	..	..	..	..	..	..	..	244	248	265	..
Zr, Fe	2,3	5	..	⊙″	4199	..	257	246	250	..	..	270	..	271	246	265	..	266	..	268	..
Fe	5	5	..	⊙′	4202	..	..	..	..	..	..	..	..	..	..	201	..	..	..	171	..
Fe	2	2	..	⊙	4215	..	..	..	..	..	..	..	..	..	..	..	..	616	..	..	..
						665	666	669	667	..	..	666	..	675	676	661	..	..	..	659	..
Sr	50	4	R	⊙ M	4215	..	..	..	..	..	..	..	..	..	..	..	692	688	687	..	688
C	..	1	..	⊙	4216†	..	..	..	..	..	..	..	..	..	..	..	..	131	128	..	..
Fe	2	4	..	⊙″	4222	381	381	405	388	..	..	390	..	380	383	374	..	380	..	374	..
Ca	50	10	R	⊙ M	4226	..	..	..	..	..	..	..	..	..	..	892	896	893	921	..	889
Fe	4	5	..	⊙′	4250	..	..	..	..	..	..	..	..	..	..	..	..	290	300	..	..
Fe	5	6	..	⊙′	4250	..	..	..	..	..	..	..	..	..	..	..	..	963	957	..	947
Cr	50	6	R	⊙″ M	4254	..	500	510	517	..	..	..	..	..	..	495	..	505	..	506	499
Fe	6	7	R	⊙	4260	..	..	..	..	..	..	..	..	..	..	..	..	643	643	..	658
− Fe	1	d 1,2	..	⊙	4267	..	..	..	934	..	..	..	..	963	982	..	..	959	..	957	..
Fe	10	7	R	⊙ M	4271	..	..	..	..	..	..	..	..	..	..	918	918	928	925	..	920
Cr	40	5	R	⊙ M	4274	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ca	4	3	R	..	4283	..	..	..	..	..	..	..	..	..	..	..	..	169	172	178	179
Ca	4	3	R	⊙	4289	..	..	..	..	..	..	..	..	..	..	520	525	526	526	528	529
Cr	30	4	R	⊙ M	4289	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	888
	..	d 4	..	⊙′	4293	..	..	246	263	..	..	..	236	..	272	238	..	244	..	252	..
Ca	2	2	R	⊙	4299	..	..	..	..	..	..	..	..	..	..	149	157	149	146	159	161
Ca	6	4	R	..	4302	..	..	..	..	..	..	..	..	..	..	686	690	695	693	693	694
Sr	8	2	..	..	4305	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	636
Ti	10	4	R	⊙ M	4306	..	..	..	..	..	..	..	..	..	..	..	..	076	079	..	080

* First line of 2d head of a carbon band.

† First line of 1st head of a carbon band.

‡ Co line measured.

⊙ M 44 II, M 29 III, M 22 IV												⊙ M 40 II, M 27 III												Mean	
Fe J c ⊙	Fe J c M	Si I J c ⊙	Si I J c M	Si I J a ⊙	Si I J a M	Si I J a ⊙	Si I J a M	Si J J a ⊙	Si J J a M	Ca M b ⊙	Na M b ⊙	Ca J c ⊙	Ca J c M	Ca M b ⊙	Co J c ⊙	Co J c M	Zr J c ⊙	Zr J c M	Ba J c ⊙	Sr J c ⊙	Mg J a ⊙	Mg J b ⊙	Mg J b ⊙	⊙	M
..	..	..	..	..	..	..	..	..	..	..	..	763	..	..	..	..	..	..	..	770	..	..	..	767	..
..	..	..	..	..	..	..	..	..	..	..	..	920	..	..	..	..	..	..	..	925	..	..	..	928	..
..	..	..	..	..	..	..	..	..	..	..	..	719	..	699	..	..	..	..	728	730	..	..	..	716	..
..	..	..	..	..	..	..	..	..	..	..	..	099	..	105	094	..	096	..	101	101	..	..	..	101	..
..	..	..	..	..	..	..	..	..	..	..	..	650	..	648	643	..	646	..	650	648	..	..	..	646	..
..	..	..	..	..	..	..	..	..	..	..	..	607	..	..	600	..	602	..	606	600	..	606	604	600	..
..	..	..	..	..	..	..	..	..	..	..	..	483	..	483	474	476	..	..	474	477	..	483	484	481	476
..	..	..	..	..	..	..	..	..	..	..	..	968	..	974	956	..	965	..	964	966	..	969	973	968	..
..	..	..	..	..	..	..	..	..	..	..	..	949	..	960	946	..	945	..	935	950	951	946	951	948	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
062	..	..	..	..	..	..	..	..	..	..	..	064	..	063	063	..	066	..	066	067	058	..	056	063	..
..	258	..	253	..	..	..	..	..	..	..	..	255	254	..	..	..	..	266	..	240	..	..	249	251	256
259	260	250	253	..	..	..	..	..	..	276	268	266	..	261	269	..	264	..	274	267	260	..	..	263	257
194	196	185	177	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	188	187
..	..	..	..	..	..	..	..	..	..	..	..	615	..	..	..	..	..	..	..	..	..	..	..	616	..
668	..	..	..	..	..	..	..	..	..	659	667	..	..	665	..	..	..	..	..	..	667	666	668	667	..
..	685	680	679	..	..	..	..	..	..	..	..	694	697	..	..	..	..	..	..	..	..	..	..	687	688
..	123	..	124	..	..	..	..	..	..	..	..	143	146	..	..	..	..	141	..	..	..	..	..	137	133
374	396	360	..	379	..	379	..	386	..	387	378	386	..	382	..	..	..	..	..	..	..	..	..	381	396
889	892	874	873	903	902	899	901	893	900	888	876	910	903	..	..	..	..	..	..	..	..	..	..	892	898
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	290	300
965	951	941	941	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	956	949
505	..	488	489	504	..	506	..	495	..	498	492	..	..	..	..	..	..	..	..	..	..	..	..	502	494
643	657	627	631	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	638	647
..	..	..	..	959	..	961	..	954	..	957	956	..	..	..	..	..	..	..	..	..	..	..	..	958	..
929	919	914	914	931	931	932	914	921	920	923	916	..	..	..	..	..	..	..	..	..	..	..	..	924	920
964	..	952	954	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	958	954
..	..	..	..	..	..	..	..	..	..	163	168	..	..	..	..	..	..	..	..	..	..	..	..	170	175
..	..	..	..	..	..	..	..	..	..	517	522	..	..	..	..	..	..	..	..	..	..	..	..	523	527
881	..	881	880	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	881	884
..	..	..	..	253	..	248	..	249	..	243	240	..	..	..	..	..	..	..	..	..	..	..	..	249	..
..	..	..	..	..	..	..	..	..	..	151	152	..	..	..	..	..	..	..	..	..	..	..	..	152	153
696	693	688	678	..	..	..	..	..	..	683	683	..	..	..	..	..	..	..	..	..	..	..	..	689	690
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	636
067	068	064	058	..	..	..	..	..	..	..	078	..	..	..	..	..	..	..	..	..	..	..	..	071	071

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St	St	U	P	E	Pl 11 ⊙59 III ⊙44 IV	Pl 10 ⊙57 III ⊙44 IV	Pl 15 ⊙44 III ⊙33 IV	Pl 1 ⊙45 III ⊙34 IV	Pl 13 ⊙42 III ⊙32 IV	Ca 46		⊙M 44 II, M 29 III, M 22 IV	
						⊙	⊙	⊙	⊙	⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	R a ⊙	J c ⊙	J c M	Ba J c ⊙	Ba J c M
Ca	3	2	R	⊙	4307	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	905	903
						. .	. .	. .	126	019	. .	957	. .	. .	. .	. .	. .	. .	. .
Fe	4	5	R	⊙	4308	. .	. .	. .	. .	. .	. .	. .	. .	. .	058	. .	. .	074	071
Ca	4	3	R	⊙″	4318	. .	. .	. .	848	827	. .	809	. .	. .	844	. .	. .	810	812
Fe	10	7	R	⊙′ M	4325	. .	. .	. .	008	977	. .	918	. .	. .	995	. .	. .	932	931
Cr, Fe	2, 2	d 1,2	. .	⊙	4343	. .	. .	. .	367	357	388	378	. .	. .	. .	. .	. .	400	. .
Fe	4	3	. .	⊙″	4352	. .	900	. .	924	916	883	889	. .	. .	. .	. .	. .	905	. .
Ni, Cr, Zr	3,4,5	1,3,1	. .	⊙	4359	. .	. .	. .	760	776	. .	758	. .	. .	. .	. .	. .	792	. .
Fe	4	5	. .	⊙″	4369	. .	940	. .	942	936	941	944	. .	. .	. .	. .	. .	947	. .
Fe	5	5	. .	⊙″	4376	103	103	. .	085	100	097	097	. .	. .	. .	. .	. .	115	. .
Fe	10	10	R	. .	4383	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	727	724	731	726
Fe, Ti	2, 1	3, 1	. .	⊙	4391*	. .	. .	. .	147	145	144	. .	169	. .	. .	142	. .	153	. .
Fe	8	8	R	⊙ M	4404	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	924	920	939	931
V, ?	9, 3	2, 3	R	⊙	4407	. .	851	. .	847	850	858	. .	856	844	. .	846	. .	857	. .
Cd	. .	. .	. .	M	4413	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	6	6	R	⊙ M	4415	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	298	294	307	298
Ca	4	4	R	⊙″ M	4425	. .	610	. .	. .	. .	. .	. .	. .	. .	. .	606	606	612	612
Ca	5	4	R	⊙ M	4435	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	128	129	141	133
Ca	3	3	R	⊙″ M	4435	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	851	854	860	861
Fe	. .	5	. .	⊙″	4447	. .	. .	. .	900	906	901	. .	892	902	. .	894	. .	909	925
Ca	8	4	R	M	4454†	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	948	948	958	956
Ca	3	2	R	M	4456‡	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	042	059	053	050
Ca	1	1	. .	M	4456	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	790	786	. .	. .
Fe	. .	5	. .	⊙″	4494	729	736	721	732	724	. .	. .	729	731	. .	742	. .	742	. .
Cr, Zr	5, 2	4, 1	. .	$⊙_1$	4497	048	039	025	066	052	. .	. .	050	059	. .	030	. .	032	. .
Mn	. .	2	. .	⊙″	4499	. .	. .	. .	210	084	. .	. .	065	061	. .	069	. .	. .	. .
		1	. .	⊙′	4499	. .	. .	. .		330	. .	. .	315	313	. .	310	. .	. .	. .
Ti	6	5	. .	⊙′	4501	444	446	435	433	451	. .	. .	445	451	. .	447	. .	445	. .
C	. .	. .	. .	M	4502.6	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ti?	. .	4	. .	⊙″	4508	460	460	. .	446	451	. .	. .	454	469	. .	458	. .	453	. .
In	. .	. .	. .	M	4511	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
In	. .	. .	. .	M	4513	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ba	100	7	R	⊙″ M	4554	. .	. .	. .	225	. .	. .	. .	. .	. .	. .	215	220	214	223
Ti	4	6	. .	⊙″	4563	. .	. .	. .	. .	. .	. .	. .	937	954	. .	942	. .	950	. .
Mg	3	5	. .	⊙″	4571	. .	. .	. .	273	282	. .	. .	287	279	. .	275	. .	287	. .
Ti	5	6	. .	⊙″	4572	. .	. .	. .	155	152	. .	. .	158	176	. .	153	. .	168	. .
Ca, Ti	3, 1	4	. .	⊙″	4578	. .	. .	. .	733	722	. .	. .	731	734	. .	733	. .	710	. .
Cr?	. .	4	. .	⊙″	4588*	. .	. .	372	397	390	. .	. .	391	395	. .	379	. .	395	. .
Ti?	. .	4	. .	⊙″	4590	. .	. .	122	133	117	. .	. .	127	149	. .	127	. .	144	. .

* Components about .05 apart.

† Violet component of double. Other line Mn.

‡ Red component of double. Other line Mn.

☉ M 44 II, M 29 III, M 22 IV														☉ 44 II		Substandard	☉ 48 II	☉ M 48 II, M 32 III, M 24 IV			Substandard	Substandard	M 48 I		Mean	
Ca J c ☉	Ca J c M	Sr J c ☉	Sr J c M	Fe J c ☉	Fe J c M	Si I′ J c ☉	Si I′ J c M	Si H J a ☉	Si H J a M	Si I J a ☉	Si I J a M	Si J J a ☉	Si J J a M	Ca M b ☉	Na M b ☉		Ca 48 M b ☉	Mg 48 J c ☉	Mg 48 J c M	Sr J c ☉	☉	M	Sr J c ☉		☉	M
905	907	. .	907	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	902	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	904	906
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	034	. .
077	079	. .	081	065	069	063	057	077	075	080	078	070	068	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	071	072
816	818	815	818	811	. .	803	. .	817	. .	817	. .	811	. .	813	816	. .	. .	. .	. .	. .	. .	. .	. .	. .	818	816
933	929	. .	937	930	932	922	921	938	938	936	937	930	930	926	939	. .	. .	. .	. .	. .	. .	. .	. .	. .	940	932
395	. .	411	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	397	393	. .	. .	. .	. .	. .	. .	. .	. .	. .	387	. .
901	. .	906	. .	907	908	897	. .	901	. .	904	. .	900	. .	906	904	. .	. .	. .	. .	. .	. .	. .	. .	. .	903	908
781	. .	800	. .	779	. .	776	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	778	. .
942	. .	952	. .	944	948	934	. .	. .	. .	. .	. .	. .	. .	950	948	. .	. .	. .	. .	. .	. .	. .	. .	. .	943	948
106	. .	. .	. .	110	108	103	. .	104	. .	104	. .	103	. .	105	106	. .	. .	. .	. .	. .	. .	. .	. .	. .	103	108
718	714	734	726	725	727	716	716	717	718	721	719	716	714	712	709	. .	. .	. .	. .	. .	*721*	*720*	729	. .	721	721
143	. .	151	. .	155	. .	142	. .	. .	. .	. .	. .	. .	. .	148	149	. .	. .	. .	. .	. .	. .	. .	. .	. .	149	. .
926	928	934	927	941	941	919	923	929	928	930	930	925	927	926	904	. .	. .	. .	. .	. .	*927*	*928*	929	. .	927	928
851	. .	856	. .	861	. .	845	. .	848	. .	849	. .	848	. .	842	843	. .	. .	. .	. .	. .	. .	. .	. .	. .	850	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	181	. .	181
. .	. .	. .	303	297	299	297	294	301	299	298	299	296	290	. .	. .	. .	. .	. .	. .	. .	*299*	*297*	308	. .	299	298
615	620	611	616	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	604	603	. .	. .	. .	. .	. .	*609*	*614*	626	. .	609	616
138	143	132	133	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	119	. .	. .	. .	. .	. .	. .	*132*	*135*	126	. .	132	133
854	860	854	857	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	836	852	. .	. .	. .	. .	. .	*851*	*858*	847	. .	852	856
905	. .	900	. .	897	899	898	. .	898	. .	896	. .	893	. .	886	907	. .	. .	. .	. .	. .	. .	. .	. .	. .	899	912
955	958	937	938	945	. .	955	960	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*950*	*952*	933	. .	950	949
045	072	. .	043	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*047*	*056*	052	. .	047	055
795	795	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	793	791
742	. .	745	. .	737	756	740	. .	737	. .	738	. .	738	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	735	756
032	. .	. .	. .	034	. .	030	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	041	. .
. .	. .	070	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	070	. .
. .	. .	305	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	315	. .
449	. .	439	. .	439	. .	450	. .	444	. .	443	. .	445	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	444	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
465	. .	446	. .	457	. .	460	. .	452	. .	452	. .	453	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	456	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	474	. .	474
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	883	. .	883
206	222	200	204	216	. .	214	219	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	*213*	*218*	205	. .	213	212
936	. .	926	. .	945	. .	945	. .	936	. .	931	. .	928	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	939	. .
257	. .	260	. .	282	. .	278	. .	. .	. .	. .	. .	. .	. .	. .	. .	*276*	279	281	281	. .	*276*	. .	. .	. .	277	281
152	. .	139	. .	158	. .	155	. .	. .	. .	. .	. .	. .	. .	. .	. .	*157*	157	163	. .	. .	*157*	. .	. .	. .	157	. .
730	. .	722	. .	741	. .	735	. .	. .	. .	. .	. .	. .	. .	. .	. .	*730*	737	744	. .	. .	*730*	. .	807	. .	731	807
374	. .	366	. .	388	. .	381	. .	. .	. .	. .	. .	. .	. .	. .	. .	*386*	380	. .	. .	. .	*386*	. .	. .	. .	384	. .
122	. .	114	. .	137	. .	126	. .	. .	. .	. .	. .	. .	. .	. .	. .	*130*	127	. .	. .	127	*130*	. .	. .	. .	129	. .

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St ⊙	St ⊙	188 ⊙	U ⊙	P ⊙	E ⊙	O ⊙	C ⊙	Pl 15 ⊙44 III ⊙33 IV R a ⊙	Pl 1 ⊙45 III ⊙34 IV R a ⊙	Pl 2 ⊙48 III ⊙36 IV R a ⊙	Pl 3 ⊙49 III ⊙37 IV R a ⊙	Pl 4 ⊙50 III ⊙38 IV R a ⊙	⊙ M 46 Ca J C ⊙	Ca J C M
Fe	2	4	. .	⊙″	4602	. .	. .	. .	. .	175	163	. .	. .	181	195	. .	. .	. .	184	. .
Li	100	. .	R	M	4602.25	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
C	. .	. .	. .	. .	4606.6	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Sr	50	2	R	⊙′ M	4607	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	514	521
?, Fe	4	d 2,6	. .	⊙₁	4611	. .	. .	. .	. .	450	438	. .	. .	. .	446	. .	. .	. .	459	. .
Ti, Co	4,5	2,3	. .	⊙′	4629	. .	. .	. .	. .	517	509	. .	. .	. .	. .	. .	. .	. .	524	. .
Fe	3	4	. .	⊙′	4637	. .	. .	. .	. .	. .	. .	. .	. .	683	684	688	. .	. .	686	. .
Fe	3	4	. .	⊙′	4638	. .	. .	. .	. .	. .	. .	. .	. .	182	223	207	. .	. .	195	. .
Fe	2	3	. .	⊙″	4643	. .	. .	. .	648	658	643	. .	. .	635	656	650	. .	. .	645	. .
Ni	6	3	R	. .	4648	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
?, Fe	3	d 7	. .	⊙′	4668	. .	. .	. .	. .	306	293	. .	. .	. .	. .	306	. .	. .	301	. .
Cd	. .	. .	. .	. .	4678	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	3	6	. .	⊙′	4679	. .	. .	. .	. .	022	020	. .	. .	. .	. .	026	. .	. .	036	. .
Zn	. .	2	. .	M	4680	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	2	2	. .	⊙″	4683	. .	745	. .	. .	728	745	. .	. .	. .	. .	748	. .	. .	747	. .
Ni	4	4	. .	⊙″	4686	. .	399	. .	. .	368	. .	. .	. .	. .	. .	397	. .	. .	401	. .
		4	. .	⊙′	4690	323	323	. .	322	345	325	. .	. .	. .	. .	322	. .	. .	323	. .
Ti, Fe	3,3	d 2,4	. .	⊙₁	4691*	575	575	. .	577	627	582	. .	. .	. .	. .	576	. .	. .	. .	. .
Mg	5	9	. .	⊙″	4703†	. .	180	. .	186	190	175	. .	. .	. .	. .	178	. .	. .	. .	. .
Ni	3	3	. .	⊙″	4703	. .	992	. .	965	973	985	. .	. .	. .	. .	991	. .	. .	. .	. .
Ni	9	6	R	M	4714	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Zn	. .	4	. .	⊙″ M	4722	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe, Mn	2,7	d 3,3	. .	⊙	4727	. .	. .	. .	. .	639	628	. .	. .	. .	. .	623	. .	. .	. .	. .
Mn	15	6	R	⊙″	4754	. .	. .	. .	. .	230	222	. .	. .	. .	. .	223	. .	. .	. .	. .
Mn	10	6	R	⊙″ M	4783	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Cd	. .	. .	. .	. .	4800	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
?, Ti	1	d 1,4	. .	⊙₁	4805	. .	. .	. .	. .	244	260	. .	. .	. .	. .	256	. .	. .	. .	. .
Zn	. .	3	. .	⊙″ M	4810	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Mn	10	6	R	⊙″ M	4823	. .	. .	695	. .	679	693	. .	. .	. .	. .	698	697	. .	. .	. .
Fe?	. .	4	. .	⊙″	4824	. .	. .	337	. .	294	319	. .	. .	. .	. .	327	325	. .	. .	. .
Fe	4	6	. .	⊙″	4859	. .	. .	. .	. .	925	. .	939	926	. .	. .	942	931	. .	. .	. .
H	. .	15	. .	⊙′	4861	. .	. .	. .	. .	503	. .	491	486	. .	. .	506	495	. .	. .	. .
Fe	7	7	. .	⊙″	4890	. .	945	. .	. .	936	. .	949	. .	. .	. .	932	943	. .	. .	. .
Ti	4	2	. .	⊙′	4900‡	. .	. .	. .	. .	098	. .	104	. .	. .	. .	. .	085	. .	. .	. .
Y	. .	2	. .	⊙′	4900‡	. .	. .	. .	. .	304	. .	302	. .	. .	. .	. .	302	. .	. .	. .
Cr, Fe	2,5	d ?6	. .	⊙″	4903	484	488	488	. .	491	. .	485	484	. .	. .	. .	492	. .	. .	. .
Pb	. .	. .	. .	M	4905	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	6	7	. .	⊙″ M	4919	. .	. .	. .	. .	. .	. .	. .	176	. .	. .	. .	189	192	. .	. .
Fe	9	t ? 9	. .	⊙″ M	4920	. .	. .	. .	. .	674	. .	. .	674	. .	. .	. .	700	679	. .	. .

* Besides the double line measured there is another faint line on the red side.

† The Mg line is of the nature of a band shaded toward the red. It coincides with the solar line when there is very little material in the arc.

‡ The Ba line comes between these and does not coincide with either.

⊙ M 44 II, M 29 III, M 22 IV					Sub-Standard	⊙ 48		⊙ M 48 II, M 32 III, M 24 IV								Sub-standard	⊙ M 48 II, M 32 III, M 24 IV			Sub-Standard	Sub-Standard	48 M I		Mean	
Ba J c ⊙	Ca J c ⊙	Ca J c M	Sr J c ⊙	Fe J c ⊙		Sn J c ⊙	Ca J c ⊙	Mg J c ⊙	Mg J c M	Ba J c ⊙	Ba J c M	Sr J c ⊙	Sr J c M	Si J b ⊙	Si J b M	⊙	Si J c ⊙	Ni J c ⊙	Ni J c M	⊙	M	Sr J c		⊙	M
211	175	. .	174	199	*185*	174	183	180	. .	189	. .	184	. .	179	. .	*185*	184	175	. .	. .	. .	. .	. .	183	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
. .	496	501	. .	. .	. .	. .	511	. .	. .	. .	508	514	484	. .	. .	. .	. .	. .	. .	*511*	*504*	517	. .	509	506
. .	. .	. .	. .	463	. .	. .	456	. .	. .	462	. .	448	. .	. .	. .	. .	. .	456	. .	. .	. .	. .	. .	453	. .
. .	. .	. .	. .	. .	. .	512	517	515	. .	518	. .	514	. .	521	. .	. .	509	512	. .	. .	. .	. .	. .	515	. .
. .	. .	. .	. .	. .	. .	681	683	675	. .	680	. .	690	. .	678	. .	. .	687	682	. .	. .	. .	. .	. .	683	. .
. .	. .	. .	. .	. .	. .	185	189	175	. .	188	. .	206	. .	194	. .	. .	194	192	. .	. .	. .	. .	. .	194	. .
. .	. .	. .	. .	. .	. .	641	639	632	. .	639	. .	650	. .	643	. .	*644*	645	645	. .	. .	. .	. .	. .	645	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	835	833	. .	. .	. .	. .	835	833
. .	. .	. .	. .	. .	. .	297	300	. .	. .	. .	. .	315	. .	298	. .	. .	. .	307	. .	. .	. .	. .	. .	303	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	339	. .	339
. .	. .	. .	. .	. .	. .	029	029	. .	. .	024	. .	040	. .	023	. .	. .	. .	029	. .	. .	. .	. .	. .	028	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	319	. .	. .	. .	. .	. .	. .	. .	. .	. .	319
. .	. .	. .	. .	. .	. .	744	743	. .	. .	. .	. .	747	. .	742	. .	*744*	. .	742	. .	. .	. .	. .	. .	743	. .
. .	. .	. .	. .	. .	. .	401	. .	. .	. .	. .	. .	401	. .	399	. .	*398*	. .	396	. .	. .	. .	. .	. .	395	. .
. .	. .	. .	. .	. .	. .	323	320	. .	. .	320	. .	324	. .	. .	. .	*322*	. .	323	. .	. .	. .	. .	. .	324	. .
. .	. .	. .	. .	. .	. .	. .	574	. .	. .	. .	. .	569	. .	. .	. .	*574*	. .	578	. .	. .	. .	. .	. .	581	. .
. .	. .	. .	. .	. .	. .	. .	182	173	249	180	. .	. .	. .	. .	. .	*180*	. .	178	. .	. .	. .	. .	. .	180	249
. .	. .	. .	. .	. .	. .	996	994	987	. .	987	. .	988	. .	. .	. .	*992*	. .	991	. .	. .	. .	. .	. .	986	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	599	598	. .	. .	. .	. .	599	598
. .	. .	. .	. .	. .	. .	345	. .	. .	326	. .	. .	. .	. .	353	352	. .	. .	. .	. .	. .	. .	. .	. .	349	339
. .	. .	. .	. .	. .	. .	624	637	. .	. .	624	. .	627	. .	630	. .	. .	. .	617	. .	. .	. .	. .	. .	628	. .
. .	. .	. .	. .	. .	. .	234	. .	213	. .	237	. .	228	. .	231	. .	. .	. .	216	. .	. .	. .	. .	. .	226	. .
. .	. .	. .	. .	. .	. .	. .	. .	601	607	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	601	607
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	097	. .	097
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	253	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	723	725	. .	. .	. .	. .	. .	. .	. .	. .	723	725
. .	. .	. .	. .	. .	. .	702	. .	693	715	. .	. .	701	. .	706	. .	. .	. .	705	. .	. .	. .	. .	. .	697	715
. .	. .	. .	. .	. .	. .	329	. .	. .	. .	. .	. .	326	. .	332	. .	. .	. .	336	. .	. .	. .	. .	. .	325	. .
. .	. .	. .	. .	. .	. .	934	. .	942	. .	936	. .	936	. .	937	. .	*935*	923	937	. .	. .	. .	. .	. .	934	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	496	. .
. .	. .	. .	. .	. .	. .	949	. .	. .	. .	952	. .	. .	. .	950	. .	*947*	. .	948	. .	. .	. .	. .	. .	945	. .
. .	. .	. .	. .	. .	. .	099	. .	. .	. .	098	. .	106	. .	102	. .	*098*	095	099	. .	. .	. .	. .	. .	098	. .
. .	. .	. .	. .	. .	. .	308	. .	. .	. .	304	. .	305	. .	308	. .	*305*	317	306	. .	. .	. .	. .	. .	306	. .
. .	. .	. .	. .	. .	. .	489	. .	. .	. .	487	. .	487	. .	. .	. .	*488*	490	486	. .	. .	. .	. .	. .	488	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	634	. .	634
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	174	. .	. .	. .	. .	. .	183	. .
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	685	. .	. .	. .	676	. .	682	676
. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St	St	188	196	p	q	o	c	C	R¹
						⊙	⊙			⊙	⊙	⊙	⊙	⊙	⊙
Fe	2	4	. .	⊙″	4924	110	107	. .	. .	109	. .	109	112	. .	. .
Fe	3	2	. .	⊙″	4924	956	955	. .	. .	954	. .	953	. .	. .	. .
Ba	100	8	R	⊙ M	4934*	. .	. .	. .	. .	243	. .	234	248	. .	. .
Ti, Fe	1,3	3	. .	⊙′	4973	. .	. .	284	. .	239	. .	249	. .	. .	. .
?, Fe	3	4	. .	⊙″	4978	. .	. .	770	. .	811	. .	765	772	. .	. .
Ni, ?	5	4,1	. .		4980	. .	. .	. .	. .	350	. .	363	. .	. .	. .
Ti	10	4	R	⊙″ M	4981	. .	. .	. .	. .	885	. .	918	. .	. .	. .
Fe	3	4	. .	⊙″	4994	. .	. .	. .	. .	317	. .	317	. .	. .	. .
Ti, La	10,10	4	R, d	⊙″	4999†	. .	. .	. .	. .	694	702	. .	. .	. .	. .
Pb	. . .	. .	. .	M	5005	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	3	4	. .	⊙′	5005	. .	. .	. .	. .	905	. .	899	. .	. .	. .
Fe	. . .	. .	. .	⊙″	5006	. .	. .	. .	. .	310	. .	295	. .	. .	. .
Ti, Fe	10,3	6	R	⊙″	5007	. .	. .	. .	. .	436	422	432	. .	. .	. .
Mg band	. . .	. .	. .	. .	5007‡	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ti, Ti	10,5	d 2,1	R	⊙′	5014	. .	. .	. .	. .	420	400	208	. .	. .	. .
Ti	7	3	. .	⊙′	5020	. .	. .	. .	. .	211	197	. .	. .	. .	. .
Ti, Ni	6,3	d 5	. .	⊙′	5036	. .	. .	. .	. .	114	081	. .	. .	. .	. .
Ca	3	2	. .	M	5041	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	5	5	. .	⊙″	5050	. .	005	. .	000	009	024	008	. .	. .	. .
Fe	2	2	. .	⊙′	5060	250	252	. .	258	255	250	250	254	. .	. .
Ti	10	3	. .	⊙′	5064	834	832	. .	. .	822	. .	840	. .	. .	. .
Fe	4	4	. .	⊙″	5068	946	947	. .	945	940	943	939	. .	. .	. .
Fe	4	3	. .	⊙″	5083	. .	525	. .	. .	518	531	. .	. .	530	. .
Cd	. . .	. .	. .	M	5087	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Fe	3	2	. .	⊙″	5090	. .	959	. .	. .	957	961	. .	. .	971	. .
Fe	3	2	. .	⊙′	5097§	. .	. .	. .	. .	157	. .	. .	. .	178	. .
Fe, (Cu)	3	3	. .	⊙″	5105	. .	718	. .	. .	740	716	721	. .	700	. .
Fe	3	3	. .	⊙″	5109	. .	. .	. .	823	821	. .	832	. .	806	. .
?, Fe	. . .	d 2,3	. .	⊙′	5110	. .	. .	. .	575	570	523	579	. .	556	. .
Ni	5	3	. .	⊙″	5115	. .	. .	. .	. .	550	556	. .	. .	542	. .
Ni, Fe	2,3	d 1,3	. .	⊙′	5121	. .	. .	. .	. .	797	785	. .	. .	785	. .
Co	3	3	. .	⊙″	5126	. .	. .	. .	. .	383	367	. .	. .	344	. .
Fe	4	4	. .	⊙″	5127	. .	. .	. .	. .	521	520	. .	. .	520	. .
Fe, ?	1	d 6	. .	⊙″	5133	. .	. .	. .	875	872	870	874	873	860	. .
Fe	4	6	. .		5139 ⎫	. .	. .	. .	. .	. .	. .	. .	. .	. .	444
						. .	. .	. .	. .	532	. .	. .	. .	530	. .
Fe	5	6	. .		5139 ⎭	. .	. .	. .	. .	. .	. .	. .	. .	. .	646
Fe	2	3	. .	⊙″	5141	. .	. .	. .	. .	901	. .	. .	. .	906	937
Ni	5	3	. .	⊙′	5142 ⎫	. .	. .	. .	. .	. .	. .	. .	. .	. .	967
						. .	. .	. .	. .	045	041	. .	. .	056	. .
Fe, Al band	3	4	. .	⊙′	5143 ⎭	. .	. .	. .	. .	. .	. .	. .	. .	. .	103

* The solar line has a component very near on the violet side.

† Ti line measured.

‡ Commencement of head.

§ Component to violet belonging to Ni ?

Pl 3 ⊙ 49 III ⊙ 37 IV	Pl 4 ⊙ 50 III ⊙ 38 IV	Pl 5 ⊙ 52 III ⊙ 39 IV	Pl 6 ⊙ 52 III ⊙ 39 IV	⊙ 48	⊙ M 48 II, M 32 III, M 24 IV				Sub-standard	Ni J c	M 52			Sub-Standard	M 48 I		Mean	
R a ⊙	R a ⊙	R a ⊙	R a ⊙	Sn J c ⊙	Mg J c ⊙	Ba J c ⊙	Sr J c ⊙	Si J b ⊙	⊙	⊙	La J c ⊙	Ca J c ⊙	Ca J c M	⊙	Sr J c M		⊙	M
101	104	..	..	109	..	112	..	120	*107*	111	..	..	..	..	..	..	109	..
958	957	..	..	952	..	956	955	..	*955*	952	..	..	..	..	..	..	955	..
256	247	..	..	..	248	256	..	..	..	242	..	..	..	..	237	..	247	237
295	266	..	..	283	285	289	..	..	..	..	..	..	..	..	..	..	274	..
785	786	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	783	..
379	357	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	362	..
931	900	..	..	919	923	928	..	..	..	..	..	..	..	*915*	893	..	915	893
326	303	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	316	..
..	674	..	..	689	699	..	..	..	..	..	..	701	..	*695*	668	..	693	668
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	634	..	634
898	893	..	..	899	913	..	..	..	..	..	909	912	..	..	..	..	904	..
299	296	..	..	..	..	..	..	..	..	..	322	313	..	..	..	..	303	..
436	419	..	..	..	..	..	..	..	..	..	437	434	..	..	..	..	431	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	478	..	478
430	420	..	..	..	..	..	..	..	..	..	441	432	..	..	412	..	422	412
216	199	..	..	..	..	..	..	..	..	..	224	213	..	..	..	..	210	..
122	111	..	..	..	..	..	..	..	..	..	130	121	..	..	..	..	113	..
..	..	..	..	..	..	..	..	..	..	..	..	795	839	..	894	..	796	867
010	005	003	..	..	..	..	..	..	..	..	008	005	..	..	..	..	008	..
253	244	255	..	..	..	..	..	..	..	..	252	249	..	..	..	..	252	..
838	831	832	..	..	..	..	..	..	..	..	832	836	..	..	..	..	833	..
950	949	949	..	..	..	..	..	..	..	..	947	947	..	..	..	..	946	..
..	530	518	..	..	..	..	..	..	..	..	..	522	..	..	..	..	525	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	001	..	001
..	958	958	..	..	..	..	..	..	..	..	..	952	..	..	..	..	959	..
..	192	177	170	..	..	..	..	..	..	..	..	179	..	..	..	..	176	..
..	730	713	722	..	..	..	..	..	..	..	710	715	..	..	..	..	719	..
..	836	827	829	..	..	..	..	..	..	..	820	831	..	..	..	..	825	..
..	589	583	574	..	..	..	..	..	..	..	572	579	..	..	..	..	579	..
..	579	542	570	..	..	..	..	..	..	..	..	568	..	..	..	..	558	..
..	808	803	792	..	..	..	..	..	..	..	..	812	..	..	..	..	797	..
..	380	368	369	..	..	..	..	..	..	..	..	373	..	..	..	..	369	..
..	534	543	531	..	..	..	..	..	..	..	..	539	..	..	..	..	530	..
..	869	874	872	..	..	..	..	..	..	..	..	871	..	..	..	..	871	..
..	..	441	..	..	..	..	..	..	..	..	..	426	..	..	..	..	437	..
..	..	..	554	..	..	..	..	..	..	..	..	..	..	..	..	..	580	..
..	..	648	..	..	..	..	..	..	..	..	..	642	..	..	..	..	645	..
..	..	925	910	..	..	..	..	..	..	..	..	..	..	..	..	..	916	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	967	..
..	..	038	029	..	..	..	..	..	..	..	..	..	..	..	..	..	042	..
..	..	..	..	..	..	..	..	..	..	..	..	109	..	..	..	..	106	..

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St	196	p ⊙	q ⊙	O ⊙	c ⊙	C ⊙	R ⊙	R¹ ⊙	Pl 5 ⊙52 III ⊙39 IV R a ⊙	Pl 6 ⊙52 III ⊙39 IV R a ⊙	Pl 8 ⊙55 III ⊙41 IV R a ⊙	⊙ M 52 II La J c ⊙	Ca J c ⊙	Ca J c M	Substandard ⊙	M 48 I Sr J c	M 56 I Sr J c	Mean ⊙	M
Ni, ?	5, ?	3	. .	⊙″	5146	. .	. .	657	680	. .	. .	650	. .	670	661	670	. .	. .	659	. .	. .	. .	. .	664	. .
Fe, Mn	4, 2	d 3,1	. .	⊙	5151*	. .	. .	016	016	. .	. .	020	. .	034	043	027	. .	. .	024	. .	. .	. .	. .	026	. .
Ti, ? Co, ?	. .	2	. .	⊙″	5154	. .	. .	222	210	. .	. .	240	. .	253	244	246	. .	. .	247	. .	. .	. .	. .	237	. .
Ni	6	2	. .	⊙″	5155	. .	. .	931	916	. .	. .	932	. .	949	942	948	. .	. .	941	. .	. .	. .	. .	937	. .
Fe, ?	. .	2	. .	⊙″	5159	. .	282	247	210	. .	. .	248	. .	233	236	243	. .	221	236	. .	. .	. .	. .	240	. .
Fe	4	4	. .	⊙″	5162	. .	. .	448	430	450	451	456	454	441	454	454	. .	438	452	. .	*447*	. .	. .	448	. .
C ‡	. .	1	. .	M	5165	. .	. .	. .	. .	. .	. .	190	. .	. .	. .	. .	. .	. .	. .	. .	. .	217	265	190	241
Fe	2	2	. .	⊙″	5165	. .	. .	558	595	. .	. .	600	619	595	574	578	. .	. .	586	. .	. .	. .	. .	588	. .
Mg	20	8	R	M	5167	. .	. .	. .	. .	. .	. .	. .	. .	498	. .	. .	. .	. .	503	. .	. .	497	479	501	488
						. .	. .	572	. .	. .	. .	565	558	. .	586	581	. .	. .	. .	. .	. .	. .	. .	572	. .
Fe	6	6	. .	M	5167	. .	. .	. .	. .	. .	. .	. .	. .	696	. .	. .	. .	. .	676	. .	. .	671	657	686	664
Fe	3	4	. .	⊙″	5169 †	. .	. .	. .	. .	. .	. .	. .	. .	067	. .	. .	. .	. .	074	. .	. .	. .	. .	066	. .
						. .	. .	158	. .	. .	. .	154	181	. .	159	152	. .	. .	. .	. .	. .	. .	. .	161	. .
Fe	3	4	. .	⊙″	5169	. .	. .	. .	. .	. .	. .	. .	. .	220	. .	. .	. .	. .	216	. .	. .	. .	. .	218	. .
Fe	5	5	. .	⊙″	5171	. .	. .	772	. .	784	776	774	807	782	793	780	. .	. .	777	. .	. .	. .	. .	783	. .
Mg	35	10	R	⊙″M	5172	. .	. .	874	. .	. .	. .	873	874	862	870	878	. .	. .	869	. .	*871*	858	873	871	866
Ti	10	. .	R	⊙″	5173	. .	. .	896	. .	917	901	891	931	922	921	910	. .	. .	917	. .	. .	. .	. .	912	. .
Mg	40	20	R	⊙″M	5183	. .	. .	789	805	. .	800	789	808	793	787	768	. .	. .	788	. .	*792*	792	789	792	791
Ti	2	4	. .	⊙″	5188	. .	. .	. .	. .	. .	. .	. .	. .	863	. .	. .	. .	. .	862	. .	. .	. .	. .	863	. .
						. .	. .	951	950	. .	. .	949	956	. .	955	926	. .	. .	. .	. .	. .	. .	. .	948	. .
Ca	6	4	. .	⊙″	5189	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ti	10	3	. .	⊙″M	5193	. .	. .	. .	. .	. .	. .	. .	. .	019	. .	. .	. .	. .	020	019	. .	. .	. .	020	019
Fe	3	4	. .	⊙″	5198	. .	. .	129	128	. .	. .	120	139	142	148	159	. .	. .	144	. .	*139*	144	123	139	134
?, Fe	?, 4	d 2,3	. .	⊙″	5202	. .	. .	884	872	. .	. .	883	906	870	886	896	. .	. .	885	. .	. .	. .	. .	885	. .
Cr, Fe	8, 3	4, 3	R	⊙″	5204	. .	. .	483	483	480	. .	469	497	459	511	476	. .	. .	488	. .	. .	. .	. .	483	. .
Ti	10	3	R	⊙″	5210	. .	. .	708	. .	711	. .	693	717	683	727	715	. .	. .	712	. .	. .	. .	. .	708	. .
Fe	3	4	. .	⊙″	5215	. .	. .	557	547	559	563	546	566	532	569	565	. .	. .	560	. .	*556*	545	552	556	549
Fe	3	4	. .	⊙″	5217	. .	. .	352	330	. .	. .	355	361	335	361	365	. .	. .	356	. .	. .	. .	. .	352	. .
Fe	2	3	. .	⊙″	5225	. .	. .	558	548	. .	. .	552	557	545	574	571	. .	. .	565	. .	. .	. .	. .	559	. .
Fe	4	4	. .	⊙″	5230	. .	. .	689	672	. .	. .	684	700	667	704	706	. .	. .	701	. .	. .	. .	. .	690	. .
Fe	7	7	. .	⊙″	5233	. .	. .	018	001	. .	. .	027	018	993	. .	. .	. .	. .	024	. .	. .	. .	. .	014	. .
Fe	3	3	. .	⊙″	5242	. .	. .	134	126	. .	. .	132	128	. .	125	124	. .	. .	128	. .	. .	. .	. .	124	. .
Fe	2	2	. .	⊙″	5250	. .	. .	652	663	. .	. .	653	673	655	655	675	660	. .	671	. .	. .	. .	. .	662	. .
Fe	3	3	. .	⊙″	5250	. .	411	. .	. .	. .	. .	392	413	391	368	392	377	382	395	. .	. .	. .	. .	391	. .
Fe	2	3	. .	⊙″	5253	. .	834	. .	. .	. .	. .	815	837	830	825	824	821	818	825	. .	. .	. .	. .	825	. .
Ca	2	1	. .	⊙M	5260	. .	. .	613	620	. .	. .	652	652	643	631	644	649	635	646	. .	. .	. .	. .	649	. .
Ca, Cr	6, 2	3	. .	⊙	5261	. .	. .	. .	. .	. .	. .	562	563	550	. .	. .	. .	. .	553	556	. .	. .	. .	557	556
		1	. .	⊙	6262	. .	. .	865	883	. .	. .	883	898	891	886	880	871	876	874	871	. .	. .	. .	880	. .
Ca	6	2	. .	⊙M	5262	. .	. .	. .	. .	. .	. .	. .	. .	341	. .	. .	. .	. .	. .	. .	. .	. .	. .	341	. .
Cr	4	3	R	⊙″	5264	. .	. .	. .	. .	. .	. .	381	375	406	. .	. .	. .	. .	403	406	. .	. .	410	391	408
						. .	. .	. .	. .	. .	. .	. .	. .	320	. .	. .	. .	. .	333	. .	. .	. .	. .	327	. .
Ca	6	3	. .	⊙″	5264	367	. .	. .	. .	. .	. .	368	378	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	371	. .
						. .	. .	. .	. .	. .	. .	. .	. .	394	. .	. .	. .	. .	396	400	. .	. .	415	395	408

* Components about .05 apart.

† Components about .138 apart as measured by Rowland.

‡ Heavy line very near the commencement of the carbon band. Much of the band can be seen on my map of the solar spectrum extending to the left.

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St ⊙	St ⊙	196 ⊙64 IV ⊙50 V ⊙42 VI	p ⊙	q ⊙	c ⊙	C ⊙	R ⊙	R' ⊙	Pl 5 ⊙52 III ⊙39 IV R s ⊙	Pl 6 ⊙52 III ⊙39 IV R s ⊙	Pl 8 ⊙55 III ⊙41 IV R s ⊙	Pl 9 ⊙55 III ⊙41 IV R s ⊙	[illegible] M 52 II Ia s c ⊙	Ca s c ⊙	Ca s c M	56 II ⊙ M Ca* s c ⊙	Sub-standard ⊙	Sub-standard M	M 56 I Fe s c	M	Mean ⊙	Mean M
Ni, Ca	4,8	3	. .		¶5265	. .	. .	. .	. .	. .	. .	. .	. .	730	. .	. .	. .	. .	. .	724	725	. .	. .	. .	. .	. .	727	725
				⊙		. .	. .	. .	. .	. .	. .	797	781	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	789	. .
Cr	4	2	R		5265	. .	. .	. .	. .	. .	. .	. .	. .	884	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	884	. .
Fe	6	6	. .	⊙″	5266	. .	730	. .	. .	. .	. .	736	720	728	731	. .	. .	. .	. .	781	. .	. .	. .	. .	738	. .	729	733
Fe	8	8	. .	⊙″	5269	717	722	734	733	726	715	730	717	719	721	711	718	. .	721	719	. .	. .	[illegible]	. .	714	. .	722	714
Ca	10	4	R	⊙″ M	†5270	. .	. .	. .	. .	. .	. .	. .	. .	457	. .	. .	. .	. .	. .	438	436	. .	448	454	454	. .	448	445
						497	492	502	490	. .	497	486	490	. .	493	503	495	. .	. .	. .	. .	. .	. .	. .	. .	. .	495	. .
Fe	6	4	. .	⊙″ M	5270	. .	. .	. .	. .	. .	. .	. .	. .	529	. .	. .	. .	. .	. .	537	. .	. .	. .	. .	. .	. .	533	. .
Fe	3	3	. .	⊙″	5273	. .	346	. .	. .	. .	. .	. .	360	351	330	338	. .	. .	. .	340	. .	. .	. .	. .	. .	. .	344	. .
						. .	. .	. .	437	440	. .	440	. .	. .	. .	. .	453	. .	. .	. .	. .	. .	. .	. .	. .	. .	443	. .
Fe	3	3	. .	⊙″	5273	. .	550	. .	. .	. .	. .	. .	544	545	561	569	. .	. .	. .	557	. .	. .	. .	. .	. .	. .	554	. .
?	?	t 2																										
Cr	5	2	. .	⊙″	5276	. .	. .	. .	191	204	. .	195	200	204	206	221	218	. .	. .	203	. .	. .	. .	. .	. .	. .	205	. .
Co	3	½																										
Fe	4	5	. .	⊙″	5281	. .	. .	. .	959	971	. .	962	966	965	955	961	967	. .	. .	965	. .	. .	. .	. .	. .	. .	968	. .
Fe	5	6	. .	⊙″	5283	. .	. .	. .	795	814	. .	810	816	799	794	790	801	. .	. .	809	. .	. .	. .	. .	. .	. .	803	. .
Fe	2	2	. .	⊙″	5288	. .	. .	708	689	721	. .	709	750	703	698	702	703	. .	. .	798	. .	. .	. .	. .	. .	. .	708	. .
Cr	70	3	R	⊙″	5296	. .	. .	. .	863	868	858	884	892	888	. .	866	864	. .	. .	870	. .	. .	. .	. .	. .	. .	873	. .
Cr	2	2	. .	⊙″	5300	. .	. .	. .	905	. .	919	914	942	. .	. .	910	911	. .	. .	926	. .	. .	. .	. .	. .	. .	918	. .
Fe	3	3	. .	⊙″	5307	. .	. .	. .	538	566	527	555	574	. .	. .	530	540	. .	. .	588	. .	. .	. .	. .	. .	. .	546	. .
Fe, ?	. .	4	. .	⊙	‡5316	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	790	. .	. .	. .	. .	. .	. .	790	. .
						. .	. .	. .	866	876	. .	858	878	. .	. .	858	881	. .	. .	. .	. .	. .	. .	. .	. .	. .	870	. .
Co, ?	2	3	. .	⊙	5316	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	950	. .	. .	. .	. .	. .	. .	950	. .
Fe	9	8	. .	⊙″	5324	. .	. .	. .	382	. .	. .	383	384	. .	. .	347	371	. .	. .	369	. .	. .	. .	. .	. .	. .	373	. .
Fe, ?	3	4	. .	⊙′	5333	. .	. .	. .	112	100	. .	089	115	. .	. .	069	090	. .	. .	066	. .	. .	. .	. .	. .	. .	092	. .
Ca	7	5	. .	⊙′ M	5349	. .	. .	. .	. .	. .	. .	639	623	. .	. .	. .	. .	. .	. .	601	599	. .	. .	. .	. .	. .	625	599
Th	. .	. .	. .	M	5350	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	650	. .	650
Fe, Ni	3, 3	4	. .	$⊙_1$	§5353	. .	. .	. .	593	600	. .	578	608	. .	. .	. .	602	. .	. .	569	. .	. .	. .	. .	. .	. .	592	. .
		2	. .	⊙	5361	. .	. .	. .	820	. .	. .	804	824	. .	. .	. .	799	. .	. .	820	. .	. .	. .	. .	. .	. .	813	. .
Fe, Co,	. .	1	. .	$⊙_1$	‖5363	. .	. .	. .	024	. .	. .	008	003	. .	. .	. .	007	. .	. .	. .	. .	. .	. .	. .	. .	. .	011	. .
?	. .	3	. .			. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	056	. .	. .	. .	. .	. .	. .	056	. .
Fe	4	6	. .	⊙″	5367	. .	. .	. .	667	681	. .	662	675	. .	. .	. .	668	. .	. .	669	. .	. .	. .	. .	. .	. .	670	. .
Fe	4	6	. .	⊙″	5370	. .	. .	. .	163	170	. .	152	168	. .	. .	. .	166	. .	. .	168	. .	. .	. .	. .	. .	. .	165	. .
Ni, Fe, Cr	2, 9, 2	d 2 7	. .	$⊙_1$	5371	. .	. .	. .	699	692	. .	665	684	. .	. .	. .	678	. .	. .	697	. .	. .	. .	. .	. .	. .	686	. .
Fe	2	3	. .	⊙″	5379	. .	. .	. .	775	784	. .	765	786	. .	. .	. .	772	. .	. .	777	. .	776	. .	. .	. .	. .	776	. .
Fe	6	6	. .	⊙″	5383	. .	. .	. .	585	576	560	571	584	. .	. .	. .	577	. .	577	576	. .	579	. .	. .	. .	. .	578	. .
Fe	3	4	. .	⊙″	5389	. .	681	. .	686	690	. .	675	682	. .	. .	. .	681	. .	683	685	. .	683	. .	. .	. .	. .	682	. .
Fe	4	5	. .	⊙″	5393	. .	377	. .	381	369	. .	382	377	. .	. .	. .	383	. .	374	375	. .	380	. .	. .	. .	. .	378	. .
Fe	7	7	. .	⊙″	5397	350	346	. .	351	343	. .	353	343	. .	. .	. .	348	. .	341	344	. .	343	346	. .	319	. .	346	319
Fe	7	7	. .	⊙″	5405	984	988	. .	991	983	985	992	991	. .	. .	. .	989	972	992	990	. .	987	987	. .	979	. .	987	979

* The correction for this series is not by theory but by a smooth curve through standards 5788 and 5791.

† This double E line measured .077 by another short series.

‡ The difference of this "1474" line measured accurately .146 by Crew and .141 by Rowland. The coincidences with Fe and Co are very doubtful, the Ca line coming more nearly between the two than coinciding with either.

§ A companion on red side.

‖ Co line near about .1 to the red.

¶ Ca line measured.

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St	p	q	c	C	R	Pl 8 ⊙55 III ⊙41 IV	Pl 9 ⊙55 III ⊙41 IV	Pl 10 ⊙57 III ⊙43 IV	⊙M 52 II		⊙M 56 II		Substandard	M 56 I	M	Mean	
						⊙	⊙	⊙	⊙	⊙	⊙	R a ⊙	R a ⊙	R a ⊙	La J c ⊙	Ca J c ⊙	Ca J c ⊙	Ca J c M	⊙	Sr J c M		⊙	M
Cr	10	5	R	⊙″	5410	. .	. .	992	. .	007	007	. .	. .	. .	. .	999	995	. .	. .	. .	. .	000	. .
Fe, Va	4,4	6	. .	⊙″	5415	418	416	425	. .	420	422	418	423	. .	433	422	414	. .	. .	. .	. .	421	. .
Va, Fe	3,5	7	. .	⊙″	5424	281	276	290	. .	283	387	282	292	. .	. .	. .	281	. .	. .	. .	. .	284	. .
Fe	5	6	. .	⊙″	5434	. .	741	733	. .	752	742	750	741	. .	. .	. .	736	. .	. .	725	. .	742	725
Fe	7	7	. .	⊙″	5447	. .	132	117	. .	147	126	100	159	. .	. .	. .	129	. .	*130*	116	. .	130	116
Fe, ?	. .	3	. .	⊙	5455	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	666	. .	. .	. .	. .	666	. .
						. .	. .	759	739	782	766	755	754	. .	. .	. .	. .	. .	. .	. .	. .	759	. .
Fe	6	6	. .	⊙	5455	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	826	. .	. .	. .	. .	826	. .
Ni	3	1	. .	⊙′	5462	. .	721	. .	760	735	735	. .	. .	. .	. .	. .	707	. .	. .	. .	. .	732	. .
Fe	3	4	. .	⊙″	5463	. .	175	. .	164	185	175	175	174	. .	. .	. .	169	. .	. .		. .	174	. .
Fe	3	4	. .	⊙″	5463	. .	494	480	484	508	484	497	504	. .	. .	. .	491	. .	. .	. .	. .	493	. .
Fe	3	3	. .	⊙″	5466	. .	607	579	602	633	618	612	601	. .	. .	. .	608	. .	. .	. .	. .	608	. .
Ni	8	4	R	⊙″	5477	. .	135	102	. .	146	124	133	127	. .	. .	. .	128	. .	. .	. .	. .	128	. .
Fe	2	3	. .	⊙′	5487	. .	977	. .	. .	. .	962	. .	. .	. .	. .	. .	964	. .	. .	. .	. .	968	. .
Fe	3	4	. .	⊙″	5497	. .	735	727	. .	748	712	. .	723	. .	. .	. .	739	. .	. .	. .	. .	731	. .
Fe	5	4	. .	⊙″	5501	. .	688	680	. .	704	676	. .	676	. .	. .	. .	687	. .	. .	. .	. .	685	. .
Fe	5	5	. .	⊙″	5507	. .	001	990	. .	018	995	. .	994	. .	. .	. .	004	. .	. .	. .	. .	000	. .
Ca	5	4	N	⊙″	5513	. .	201	192	. .	222	203	. .	203	. .	. .	. .	203	127	. .	. .	. .	207	127
Mg	10	7	. .	⊙″	5528*	. .	643	631	. .	653	623	. .	630	. .	. .	. .	634	. .	. .	. .	672	636	672
Fe	. .	2	. .	⊙″	5535	. .	066	067	. .	086	095	. .	057	. .	. .	. .	064	. .	. .	. .	. .	073	. .
Fe	3	2	. .	⊙″	5543	. .	422	. .	400	424	445	. .	407	. .	. .	. .	410	. .	. .	. .	. .	418	. .
Fe	3	2	. .	⊙″	5544	. .	162	123	155	171	167	. .	167	. .	. .	. .	159	. .	. .	. .	. .	158	. .
Fe	4	3	. .	⊙″	5555	. .	123	103	. .	119	115	. .	110	. .	. .	. .	108	. .	. .	. .	. .	113	. .
Fe	6	5	. .	⊙″	5569	. .	853	836	. .	853	850	. .	850	. .	. .	. .	846	. .	. .	. .	. .	848	. .
Fe	5	4	. .	⊙″	5576	. .	325	. .	. .	315	321	. .	312	. .	. .	. .	324	. .	*319*	. .	. .	319	. .
Ca	6	4	. .	⊙″	5582	. .	207	175	. .	195	200	. .	193	197	. .	. .	196	203	. .	204	. .	195	204
Ca	10	6	R	⊙″	5588	. .	991	970	. .	984	972	. .	976	982	. .	. .	983	975	*979*	979	. .	980	977
Ca	5	4	. .	⊙″	5590	. .	. .	. .	. .	350	334	. .	. .	. .	. .	. .	342	348	. .	355	. .	342	352
Ca	7	5	R	⊙	5594	. .	. .	. .	. .	711	682	. .	. .	. .	. .	. .	691	685	. .	693	. .	695	689
Fe	3	2	. .	⊙′	5598	. .	. .	. .	. .	528	581	. .	. .	. .	. .	. .	. .	. .	. .	563	. .	555	563
Ca	7	4	. .	⊙′	5598	. .	. .	. .	. .	715	715	. .	. .	. .	. .	. .	715	708	. .	715	. .	715	712
Ca	5	4	. .	⊙″	5601	. .	. .	. .	. .	501	495	. .	. .	. .	. .	. .	506	512	. .	491	. .	501	502
Fe	2	t{2																					
Ca	6	4	. .	⊙′	5603†	097	114	090	. .	108	089	. .	101	098	. .	. .	081	. .	. .	. .	. .	097	. .
Fe	5	4																					
Fe	2	2	. .	⊙′	5615	528	530	510	. .	511	547	. .	524	531	. .	. .	527	. .	. .	. .	. .	526	. .

* This Mg. line is shaded to one side with much Mg. in the arc. The solar line corresponds to the extreme edge of this band-like line.

† Wave length of components about as follows: 5603.00, 5603.06, 5603 17.

	Intensity in Arc	Intensity in Sun	Kind of Standard		⊙	⊙	188	p ⊙	q ⊙	o	c ⊙	C	R	h	Pl 16 ⊙59 II R	Pl 17 ⊙59 II R	Pl 17 R	Pl 18 ⊙59 II R	Pl 9 ⊙55 III R	Pl 10 ⊙57 III R	Pl 11 ⊙59 III R	⊙M Ca	*	Mean ⊙	Mean *
Fe	2	6	⊙″	5615	. .	879	. .	877	880	. .	. .	880	872	. .	. .	. .	. .	. .	886	878	. .	881	. .	879	. .
Fe	2	2	⊙″	5624	254	252	258	244	. .	. .	248	270	268	. .	. .	. .	. .	. .	239	246	. .	248	. .	253	. .
Fe, Va	5, 2	4	⊙″	5624	764	766	756	769	798	762	766	772	744	. .	. .	. .	. .	. .	774	770	. .	771	. .	768	. .
Fe	2	3	⊙″	5634	. .	. .	. .	. .	. .	167	. .	158	173	. .	. .	. .	. .	. .	. .	. .	. .	169	. .	167	. .
Fe	2	3	⊙″	5641	. .	661	. .	664	664	. .	. .	647	667	. .	. .	. .	. .	. .	661	660	. .	666	. .	661	. .
Si	. .	2	⊙	5645	. .	. .	. .	830	810	. .	. .	833	841	. .	. .	. .	. .	. .	817	872	. .	840	. .	885	. .
Fe	2	4	⊙′	5655	. .	. .	. .	716	709	. .	. .	695	706	. .	. .	. .	. .	. .	702	710	. .	714	. .	707	. .
Y	1	4	⊙″	5658	. .	. .	. .	097	. .	093	. .	106	104	. .	. .	. .	. .	. .	089	086	. .	100	. .	096	. .
Fe	3	5	⊙″	5662	. .	. .	. .	756	738	. .	. .	739	756	. .	. .	. .	. .	. .	740	736	. .	747	. .	745	. .
Ti	3	2	⊙	5675	. .	. .	. .	669	642	. .	. .	640	650	. .	. .	. .	. .	. .	. .	638	. .	647	. .	648	. .
Fe	2	3	⊙″	5679	. .	. .	. .	255	. .	251	. .	244	251	. .	. .	. .	. .	. .	. .	243	. .	248	. .	249	. .
Na	3	4	⊙″	5682	. .	. .	. .	867	856	862	. .	859	866	. .	. .	. .	. .	. .	. .	852	. .	866	. .	861	. .
Na	. .	6	⊙″	5688	. .	. .	. .	447	. .	. .	. .	418	431	. .	. .	. .	. .	. .	. .	434	. .	439	. .	434	. .
Fe	4	5	⊙″	5701	. .	. .	. .	784	765	. .	. .	738	783	. .	. .	. .	. .	. .	. .	764	. .	777	. .	769	. .
Si	. .	5	⊙″	5708	. .	. .	. .	. .	. .	. .	. .	595	639	. .	. .	. .	. .	. .	. .	. .	. .	625	. .	620	. .
Fe	. .	6	⊙	5709	. .	. .	. .	645	. .	623	. .	583	623	. .	. .	. .	. .	. .	. .	. .	. .	606	. .	616	. .
Ni	5	5	⊙	5709	. .	. .	. .	767	. .	770	. .	729	769	. .	. .	. .	. .	. .	. .	749	. .	776	. .	760	. .
Mg	. .	. .	M	5711*	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	374	. .	374
Ni,	5, 3	5	⊙″	5715	. .	. .	. .	318	304	311	. .	293	332	. .	. .	. .	292	. .	. .	310	. .	311	. .	309	. .
Fe, Ti																									
Fe	. .	5	⊙″	5731	. .	. .	. .	003	954	967	. .	967	989	. .	. .	. .	976	. .	. .	945	. .	984	. .	978	. .
Fe	. .	3	⊙	5742	. .	. .	. .	091	056	. .	. .	050	068	060	. .	. .	064	. .	. .	070	. .	072	. .	066	. .
Fe	. .	4	⊙″	5752	. .	. .	. .	268	247	. .	. .	256	262	265	. .	. .	254	. .	. .	251	. .	255	. .	257	. .
Fe	. .	5	⊙″	5753	. .	. .	. .	350	341	. .	. .	328	336	350	. .	. .	342	. .	. .	336	. .	350	. .	342	. .
Ni, ?	5,	5	⊙″	5754	. .	. .	. .	900	. .	. .	. .	868	892	888	. .	. .	874	. .	. .	881	. .	883	. .	884	. .
Fe	. .	7	$⊙_1$	5763†	. .	. .	. .	228	216	. .	. .	208	216	. .	. .	. .	. .	. .	. .	202	. .	220	. .	215	. .
Si	. .	5	⊙″	5772	. .	. .	. .	371	362	. .	. .	358	343	. .	. .	. .	. .	. .	. .	. .	. .	360	. .	360	. .
Fe	. .	5	⊙″	5775	. .	. .	. .	312	297	299	. .	300	316	. .	. .	. .	. .	. .	. .	308	. .	299	. .	304	. .
Cu?, Co?	. .	d 7	⊙″	5782	. .	. .	. .	341	364	. .	. .	342	360	. .	. .	. .	. .	. .	. .	339	326	340	. .	340	. .
Cr	6	4	⊙″	5784	. .	. .	. .	088	. .	077	. .	073	108	. .	. .	. .	075	. .	. .	085	082	078	. .	081	. .
Cr	7	5	⊙″	5788	. .	. .	134	148	. .	140	. .	131	152	. .	124	136	152	. .	. .	140	126	142	. .	139	. .
Cr, Fe	10,	d 7	⊙″	5791	. .	. .	202	208	206	202	. .	205	231	232	196	193	205	. .	. .	202	208	203	. .	207	. .
		4	⊙″	5798	. .	. .	. .	. .	. .	. .	. .	095	123	. .	065	067	076	088	. .	. .	. .	093	. .	087	. .
Fe	. .	4	⊙″	5798	. .	. .	. .	389	410	. .	. .	390	417	. .	. .	. .	398	. .	. .	391	. .	404	. .	400	. .
Ni	7	5	⊙″	5805	. .	. .	. .	441	437	. .	. .	440	481	. .	. .	. .	440	. .	. .	. .	. .	446	. .	448	. .
Fe	. .	5	⊙″	5806	. .	. .	. .	. .	. .	. .	. .	947	965	960	. .	. .	950	. .	. .	. .	. .	946	. .	954	. .
Fe	. .	5	⊙″	5809	. .	. .	. .	437	. .	. .	. .	445	456	438	426	435	442	437	. .	422	438	433	. .	437	. .

* This Mg. line is shaded to one side especially with much Mg. in the arc. The corresponding solar line is at 5711, 318.

† Companion to violet.

	Intensity in Arc	Intensity in Sun	Kind of Standard		St	St	188	p	q	o	c	C	R	C	Pl 20 62 I 31 II	Pl 16 59 II 39 III	Pl 17 59 II 39 III		Pl 18 59 II 39 III	Pl 10 57 III 43 IV	Pl 11 59 III 44 IV	$\odot$ M 56 II / Ca J c	Sub-standard	Mean	
					$\odot$	$\odot$	$\odot$	$\odot$	$\odot$	$\odot$	$\odot$	$\odot$	$\odot$	$\odot$	R a $\odot$	R a $\odot$	R a $\odot$		R a $\odot$	R a $\odot$	R a $\odot$	$\odot$	$\odot$	$\odot$	M
Fe	. .	6	$\odot_1$	5816*	. .	. .	. .	584	594	. .	. .	589	609	. .	. .	591	597	603	605	579	586	600	. .	594	. .
Ni	3	3	$\odot'$	5831	. .	. .	. .	829	827	. .	. .	822	862	. .	. .	. .	. .	819	. .	. .	. .	. .	. .	832	. .
Ba	10	5	$\odot''$	5853	. .	. .	. .	905	919	. .	. .	903	889	909	905	900	896	904	904	. .	896	. .	. .	903	. .
Ca	10	7	$\odot'$	5857	. .	. .	667	664	. .	. .	. .	679	671	681	673	670	665	679	675	. .	669	. .	. .	672	. .
Fe	. .	6	$\odot''$	5859	. .	812	811	802	806	. .	. .	820	815	812	813	804	807	814	807	. .	. .	. .	. .	810	. .
Fe	. .	6	$\odot''$	5862	582	583	581	568	. .	. .	. .	587	566	581	584	578	574	584	588	. .	585	. .	. .	580	. .
Fe	. .	6	$\odot_1$	5884†	. .	. .	. .	. .	. .	. .	. .	061	048	035	051	048	048	043	040	. .	058	. .	. .	048	. .
A	. .	1–5	$\odot_1$	5889	. .	. .	. .	. .	. .	862	. .	841	853	876	840	. .	. .	847	. .	. .	. .	. .	. .	854	. .
Na	. .	15	$\odot'$	5890	184	182	184	193	181	190	181	190	158	184	185	185	176	184	170	. .	186	. .	*182*	182	. .
Ni	. .	4	$\odot$	5893	. .	. .	. .	090	103	. .	. .	105	083	104	088	097	101	098	094	. .	117	. .	. .	098	. .
Na	. .	10	$\odot''$	5896	157	157	148	165	165	151	141	159	137	138	146	158	162	155	160	. .	165	. .	*154*	154	. .
A, Fe	. .	d,4	$\odot_1$	5898	. .	. .	392	392	. .	. .	. .	416	377	408	396	. .	. .	377	. .	. .	398	. .	. .	395	. .
A, Fe	. .	d	$\odot_1$	5901	. .	. .	. .	706	. .	. .	. .	720	682	705	674	674	643	673	676	. .	657	. .	. .	681	. .
Fe	. .	5	$\odot''$	5905	. .	894	. .	893	897	. .	. .	896	906	885	887	891	902	894	894	. .	897	. .	. .	895	. .
Fe, ?	. .	d,4.5	$\odot''$	5914‡	386	386	. .	382	. .	381	391	370	382	387	379	385	393	378	395	. .	387	. .	. .	384	. .
Fe	. .	5	$\odot''$	5916	. .	471	489	473	. .	. .	481	460	496	478	466	474	473	470	478	. .	466	. .	. .	475	. .
A	. .	4	$\odot''$	5919	. .	. .	. .	866	. .	861	. .	837	864	. .	849	853	862	850	. .	. .	849	. .	. .	855	. .
Fe	. .	6	$\odot''$	5930	. .	. .	. .	406	427	. .	. .	400	436	402	400	408	406	402	409	. .	414	. .	. .	410	. .
Fe	. .	6	$\odot''$	5934	. .	. .	. .	883	881	. .	. .	866	913	. .	869	880	885	880	871	. .	902	. .	. .	883	. .
Si	. .	6	$\odot''$	5948	. .	. .	. .	744	775	742	. .	763	777	767	747	758	773	760	768	. .	. .	. .	. .	761	. .
Fe	. .	5	$\odot''$	5956	. .	. .	. .	932	919	. .	. .	927	949	. .	904	918	922	920	930	. .	. .	. .	. .	925	. .
Fe	. .	4	$\odot''$	5975	. .	. .	. .	576	585	. .	. .	572	589	. .	558	566	571	570	595	. .	. .	. .	. .	576	. .
Fe	. .	5	$\odot$	5977	. .	. .	. .	004	014	. .	. .	996	046	994	993	999	000	998	009	. .	. .	. .	. .	005	. .
A	. .	. .		5977	. .	. .	. .	. .	. .	. .	. .	. .	254	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	254	. .
Fe	. .	6	$\odot''$	5985	. .	. .	. .	037	061	. .	. .	035	058	. .	028	. .	. .	. .	. .	. .	. .	. .	. .	044	. .
Fe	. .	6	$\odot''$	5987	. .	. .	. .	287	293	270	. .	282	312	. .	273	. .	. .	. .	. .	. .	. .	. .	. .	286	. .
Fe	. .	6	$\odot''$	6003	. .	. .	. .	244	259	. .	. .	231	276	232	228	. .	. .	. .	. .	. .	. .	. .	. .	245	. .
Fe	. .	4	$\odot''$	6008	. .	. .	. .	. .	. .	. .	. .	. .	215	. .	177	. .	. .	. .	. .	. .	. .	. .	. .	196	. .
Fe	. .	6	$\odot''$	6008	. .	. .	. .	768	776	. .	. .	777	810	. .	778	. .	. .	. .	. .	. .	. .	. .	. .	782	. .
Mn	10	6	$\odot''$	6013	. .	. .	. .	702	. .	. .	. .	737	730	. .	700	. .	. .	. .	. .	. .	. .	. .	. .	717	. .
Mn	10	6	$\odot''$	6016	. .	. .	. .	862	856	841	. .	873	887	826	847	. .	. .	. .	. .	. .	. .	. .	. .	856	. .
?, Fe	. .	d,3,5	$\odot_1$	6020§	. .	. .	. .	350	345	. .	. .	342	366	. .	330	. .	. .	. .	. .	. .	. .	. .	. .	347	. .
Mn	10	6		6022	. .	. .	. .	019	. .	. .	. .	021	025	013	007	. .	. .	. .	. .	. .	. .	. .	. .	017	. .
Fe	. .	6	$\odot'$	6024	. .	. .	. .	273	288	263	. .	295	290	279	270	. .	. .	. .	. .	. .	. .	. .	. .	280	. .
Fe	. .	4	$\odot''$	6027	. .	. .	. .	268	258	. .	. .	276	262	263	260	. .	. .	. .	. .	. .	. .	. .	. .	265	. .
Fe	. .	4	$\odot''$	6042	. .	. .	. .	296	326	310	. .	344	335	307	305	. .	. .	. .	. .	. .	. .	. .	. .	316	. .

* Companion to violet.

† An atmospheric line is very near this to red. Distance about .08.

‡ Components about .1 apart.

§ Components about .2 apart.

	Intensity in Arc	Intensity in Sun.	Kind of Standard		188 * ⊙	196 ⊙	p ⊙	q ⊙	o ⊙	e ⊙	C ⊙	R ⊙	h ⊙	i ⊙	a ⊙	Pl 20 ⊙62 I ⊙31 II J c ⊙	M J ⊙	Mean ⊙	Mean M
Fe	. .	5	⊙″	6056	. .	. .	210	245	215	. .	246	260	. .	. .	. .	214	. .	232	. .
Fe	. .	7	⊙″	6065	729	. .	704	705	692	707	720	731	701	695	. .	698	. .	708	. .
Fe	. .	5	⊙″	6078	719	. .	701	713	703	698	731	720	704	698	. .	700	. .	709	. .
Fe	. .	3	⊙″	6079	244	. .	200	. .	207	212	240	240	220	231	. .	211	. .	223	. .
Fe	. .	. .	⊙′	6102	. .	. .	. .	. .	. .	. .	. .	415	. .	401	. .	. .	. .	408	. .
Ca	10	6	⊙″	6102	. .	. .	. .	934	. .	. .	938	973	948	922	. .	932	. .	941	. .
Fe, ?	. .	d, 4, 1	$⊙_1$	6103*	. .	. .	385	. .	. .	. .	444	458	. .	440	. .	420	. .	449	. .
Li	. .	. .	M	6103	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	812	. .	812
Ni	5	6	⊙″	6108	. .	. .	. .	333	339	. .	333	353	. .	. .	. .	338	. .	338	. .
Ni	4	4	⊙′	6111	. .	. .	274	. .	285	. .	287	300	. .	. .	. .	287	. .	287	. .
Fe	.5	6	⊙″	6116	. .	. .	406	. .	420	. .	414	424	. .	. .	. .	411	. .	415	. .
Ca	15	9	⊙″	6122	. .	. .	424	406	421	. .	427	464	436	416	. .	429	. .	428	. .
Fe	. .	8	⊙′	6136	. .	. .	829	832	836	. .	813	857	. .	. .	. .	834	. .	834	. .
Fe, Ba	,15	7	⊙″	6141	. .	. .	937	929	. .	. .	918	945	930	. .	. .	934	. .	934	. .
Na	. .	3	⊙″	6154	. .	. .	. .	. .	405	. .	424	465	. .	. .	. .	. .	. .	431	. .
Na	. .	5	⊙″	6160	. .	. .	. .	. .	. .	. .	948	991	. .	. .	. .	. .	. .	970	. .
Ca	15	10	⊙″	6162	. .	. .	385	391	. .	. .	380	375	377	. .	. .	387	. .	383	. .
Ca	6	6	⊙″	6169	. .	. .	. .	. .	. .	. .	245	274	. .	. .	. .	. .	. .	260	. .
Ca	7	7	⊙″	6169	. .	. .	772	771	. .	. .	760	797	. .	. .	. .	776	. .	775	. .
Fe	. .	6	⊙″	6173	. .	. .	545	. .	. .	. .	540	581	548	. .	. .	554	. .	554	. .
Ni	5	6	⊙″	6177	. .	. .	011	023	. .	. .	026	052	. .	. .	. .	027	. .	028	. .
Fe	. .	6	⊙″	6180	. .	. .	418	410	. .	. .	407	441	. .	. .	. .	418	. .	419	. .
Ni	4	6	⊙″	6191	. .	. .	363	. .	. .	. .	380	432	381	430	. .	398	. .	397	. .
Fe	. .	7	⊙″	6191	. .	. .	777	767	. .	. .	764	788	759	754	. .	783	. .	770	. .
Fe	. .	6	⊙″	6200	. .	. .	524	542	528	. .	520	557	522	. .	. .	535	. .	533	. .
Fe	. .	6	⊙″	6213	. .	. .	640	651	. .	. .	640	674	628	. .	. .	643	. .	646	. .
Fe	. .	6	⊙″	6219	. .	. .	497	499	489	. .	473	522	480	. .	. .	494	. .	493	. .
Fe, Va	,6	7	⊙″	6230	959	. .	938	949	. .	938	914	958	957	946	. .	951	. .	946	. .
		4	⊙″	6237	. .	. .	525	. .	517	. .	515	537	. .	. .	. .	552	. .	529	. .
Fe	. .	7	⊙″	6246	. .	. .	527	540	528	. .	514	536	. .	. .	. .	534	. .	530	. .
Fe	. .	7	⊙″	6252	. .	. .	766	774	. .	. .	761	786	793	. .	. .	776	. .	776	. .
Fe	. .	7	⊙″	6284	. .	. .	446	456	. .	. .	443	455	464	. .	. .	459	. .	454	. .
Ni, Fe	7,	6	⊙″	6256	. .	. .	575	570	. .	. .	561	586	. .	. .	. .	577	. .	574	. .
Ti	5	2	⊙″	6261	. .	296	310	. .	. .	. .	320	334	313	. .	. .	324	. .	316	. .
Fe	. .	5	⊙″	6265	. .	333	342	346	355	. .	343	364	344	. .	. .	349	. .	347	. .
Fe	. .	3	⊙″	6270	. .	. .	436	437	445	. .	413	460	436	. .	. .	445	. .	439	. .
A	. .	4	⊙″	6278	. .	. .	285	279	. .	. .	274	305	290	. .	298	293	. .	289	. .

* Components about .1 apart.

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St	St	188	196	p ⊙	q ⊙	O ⊙	c ⊙	C ⊙	R ⊙	h ⊙	i ⊙	a	t	Pl 20 ⊙62 ⊙31 J c ⊙		Pl 21 J c ⊙	Mean ⊙	Mean M
A	. .	2	. .	⊙′	6281	. .	. .	. .	. .	373	. .	379	. .	365	. .	380	. .	373	. .	376	. .	. .	374	. .
A	. .	2	. .	⊙′	6289	. .	. .	. .	. .	. .	. .	. .	. .	603	. .	. .	635	595	. .	598	. .	. .	608	. .
A	. .	3	. .	⊙	6293*	. .	. .	. .	. .	168	132	. .	. .	147	. .	. .	. .	153	. .	160	. .	. .	152	. .
A	. .	3	. .	⊙″	6296	. .	147	. .	. .	153	119	. .	. .	137	. .	. .	. .	137	. .	172	. .	. .	144	. .
Fe	. .	7	. .	⊙″	6301	. .	714	. .	. .	. .	725	. .	. .	715	724	. .	. .	721	. .	712	. .	. .	719	. .
Ni	6	4	. .	⊙″	6314	. .	874	. .	. .	. .	. .	. .	. .	870	870	873	. .	871	. .	884	. .	. .	874	. .
Fe	. .	3	. .	$\odot_1$	6315†	. .	. .	. .	. .	. .	. .	. .	. .	545	535	. .	. .	524	. .	558	. .	. .	541	. .
Fe, (Ca)	. .	6	. .	⊙″	6318	241	244	245	234	232	253	245	240	248	244	229	. .	246	. .	241	. .	. .	242	. .
Fe	. .	5	. .	⊙″	6322	912	909	921	917	900	. .	905	917	917	903	917	. .	914	. .	908	. .	. .	912	. .
Fe	. .	6	. .	⊙″	6338	. .	549	553	. .	555	546	550	551	542	554	556	540	. .	. .	553	. .	. .	550	. .
Fe	. .	6	. .	⊙″	6337	. .	043	030	. .	041	043	051	028	041	042	043	048	. .	. .	047	. .	. .	042	. .
Fe	. .	5	. .	⊙″	6344	. .	. .	. .	. .	383	356	. .	. .	370	363	. .	. .	. .	. .	376	. .	. .	370	. .
Fe	. .	5	. .	⊙	6355†	. .	. .	. .	. .	258	270	253	. .	250	264	248	. .	. .	. .	267	. .	. .	259	. .
Fe	. .	6	. .	⊙″	6358	. .	. .	. .	. .	897	907	914	. .	893	897	908	. .	. .	. .	899	. .	. .	902	. .
Ni	5	2	. .	⊙	6378	. .	. .	. .	. .	. .	. .	. .	. .	. .	450	. .	472	. .	. .	. .	. .	. .	461	. .
Fe	. .	4	. .	⊙″	6380	. .	. .	. .	. .	. .	965	. .	. .	938	930	. .	961	. .	. .	960	. .	. .	951	. .
Fe	. .	7	. .	⊙″	6393	. .	. .	. .	. .	827	824	809	. .	801	800	837	818	. .	. .	828	. .	. .	818	. .
Fe	. .	8	. .	⊙′	6400	. .	. .	. .	. .	. .	. .	. .	. .	170	213	. .	199	. .	. .	219	. .	. .	200	. .
Fe	. .	3	. .	⊙′	6400	. .	. .	. .	. .	. .	. .	. .	. .	464	486	526	527	. .	. .	542	. .	. .	509	. .
Fe	. .	6	. .	⊙″	6408	. .	. .	. .	. .	246	. .	250	. .	205	218	243	220	. .	. .	237	. .	. .	231	. .
Fe	. .	7	. .	⊙″	6411	. .	. .	. .	864	878	892	861	. .	843	837	872	859	. .	. .	872	. .	. .	864	. .
Fe	. .	5	. .	⊙″	6420	. .	. .	. .	180	. .	. .	175	. .	150	153	181	184	. .	. .	177	. .	. .	171	. .
Fe	. .	6	. .	⊙	6421†	. .	. .	. .	593	580	577	583	. .	545	553	555	568	. .	. .	571	. .	. .	569	. .
Fe	. .	6	. .	⊙″	6431	. .	. .	. .	074	065	063	078	. .	030	033	078	064	. .	. .	084	. .	. .	063	. .
Cd	. .	. .	. .	M	6438	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	680	. .	. .	680
Ca	10	7	. .	⊙″	6439	. .	. .	. .	307	312	314	300	. .	277	274	301	300	. .	. .	297	. .	314	298	. .
Ca	5	6	. .	⊙″	6450	. .	. .	. .	057	038	033	. .	. .	000	015	. .	. .	. .	. .	. .	. .	049	029	. .
Ca, Fe	10	d {9 3}	. .	⊙″	6462	. .	. .	. .	. .	852	876	. .	. .	837	801	822	819	. .	. .	838	. .	884	835	. .
Ca	5	5	. .	⊙″	6471	. .	. .	. .	. .	892	894	. .	. .	865	870	. .	. .	. .	. .	885	. .	911	881	. .
A	. .	1	. .	⊙	6480	. .	. .	. .	. .	285	. .	. .	. .	250	259	. .	. .	. .	. .	260	. .	267	264	. .
	. .	4	. .	⊙″	6482	. .	. .	. .	. .	106	111	. .	. .	070	072	125	110	. .	. .	096	. .	100	099	. .
Ca *	8	6	. .	⊙″	6494	. .	. .	. .	034	002	019	. .	. .	962	982	997	003	. .	. .	011	. .	012	001	. .
Fe	. .	7	. .	⊙″	6495	. .	. .	. .	. .	214	226	. .	. .	186	192	202	222	. .	. .	221	. .	224	209	. .
Ca	5	5	. .	⊙″	6499	. .	. .	. .	. .	881	. .	875	. .	852	864	870	881	. .	864	879	. .	885	871	. .
	6	4	. .	⊙	6516	. .	. .	. .	. .	311	323	. .	. .	292	317	. .	. .	. .	313	340	. .	. .	315	. .
Fe	. .	4	. .	⊙′	6518	. .	. .	. .	. .	609	602	578	. .	590	578	599	596	. .	603	596	. .	. .	594	. .

* Companion near to violet.

† Companion near to red.

	Intensity in Arc	Intensity in Sun	Nature in Arc	Kind of Standard		St	St	u ⊙	196 ⊙	p ⊙	q ⊙	O ⊙	C ⊙	R ⊙	h ⊙	l ⊙	C′ ⊙	t	Pl 20 ⊙62 I ⊙31 II ⊙	Pl 21 ⊙	m	Pl 22 ⊙	Pl 23 ⊙	Mean ⊙	Mean m
		1	. .	⊙	6532	. .	. .	. .	. .	576	. .	. .	517	563	567	. .	. .	. .	509	557	. .	. .	. .	546	. .
		3	. .	⊙″	6534	. .	172	. .	. .	179	150	185	171	169	166	191	. .	. .	173	183	. .	. .	. .	173	. .
Ti, Fe	3	6	. .	⊙″	6546	. .	483	. .	495	. .	469	. .	481	492	484	501	. .	. .	481	473	. .	. .	. .	486	. .
		2	. .	⊙	6552	. .	. .	. .	. .	. .	. .	. .	800	845	835	. .	. .	870	849	. .	. .	. .	. .	840	. .
H	. .	30	. .	⊙″	6563	049	047	. .	072	051	086	040	044	043	063	031	. .	065	. .	060	. .	. .	. .	054	. .
Fe	. .	6	. .	⊙″	6569	461	462	. .	455	460	454	. .	471	471	461	451	. .	. .	468	461	. .	. .	. .	461	. .
		1	. .	⊙	6572	. .	. .	. .	. .	336	. .	324	276	318	. .	. .	. .	. .	. .	298	. .	. .	. .	312	. .
		2	. .	⊙	6574	. .	. .	. .	. .	473	. .	. .	469	490	. .	. .	. .	. .	. .	466	. .	. .	. .	477	. .
Fe	. .	4	. .	$\odot_1$	6575*	. .	. .	. .	. .	203	. .	153	165	181	172	197	. .	. .	. .	(053) (275)	. .	. .	. .	179	. .
Fe	. .	5	. .	⊙″	6593	. .	167	. .	143	160	. .	166	153	168	168	173	. .	152	. .	156	. .	. .	. .	161	. .
Fe	. .	4	. .	⊙″	6594	. .	116	. .	097	113	109	121	128	130	114	113	. .	110	. .	113	. .	. .	. .	115	. .
Fe	. .	4	. .	⊙″	6609	. .	. .	. .	320	360	346	. .	366	369	370	. .	. .	346	. .	351	. .	. .	. .	354	. .
Fe	. .	3	. .	⊙	6633	. .	. .	. .	. .	981	991	. .	985	014	. .	. .	. .	991	. .	996	. .	. .	. .	992	. .
Ni	5	5	. .	⊙″	6643	. .	. .	. .	. .	877	873	880	880	902	877	917	. .	872	. .	875	. .	. .	. .	882	. .
		1	. .	⊙″	6663	. .	. .	. .	. .	. .	. .	. .	513	537	. .	. .	. .	. .	. .	473	. .	. .	. .	525	. .
Fe	. .	4	. .	⊙″	6663	. .	. .	. .	. .	677	693	. .	693	719	. .	. .	. .	. .	. .	694	. .	. .	. .	696	. .
Fe	. .	5	. .	⊙″	6678	. .	. .	. .	. .	231	241	238	244	280	232	227	. .	247	. .	237	. .	. .	. .	232	. .
		2	. .	⊙	6703	. .	. .	793	. .	801	. .	807	820	823	816	830	. .	. .	. .	818	. .	812	. .	813	. .
		3	. .	⊙	6705	. .	. .	334	. .	337	347	366	343	372	352	372	. .	. .	. .	358	. .	350	. .	353	. .
Li	. .	. .	. .	M	6708	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	090	. .	. .	. .	090
Ca	10	4	. .	⊙	6717*	. .	. .	. .	. .	928	929	924	944	951	926	923	. .	. .	. .	935	. .	942	. .	934	. .
		3	. .	⊙	6722	. .	090	. .	. .	080	101	096	112	085	101	. .	. .	. .	. .	086	. .	093	. .	095	. .
Fe	. .	3	. .	⊙	6726	. .	. .	. .	. .	. .	924	. .	926	922	922	. .	. .	. .	. .	921	. .	920	. .	923	. .
Fe	. .	4	. .	⊙″	6750	409	409	435	. .	409	408	419	403	424	396	418	. .	. .	. .	. .	. .	409	. .	412	. .
Fe	. .	2	. .	⊙′	6752	. .	964	. .	. .	982	. .	944	957	963	. .	. .	. .	. .	. .	. .	. .	960	. .	962	. .
Ni	5	4	. .	⊙″	6768	. .	. .	. .	. .	021	104	082	013	032	030	037	. .	. .	. .	. .	. .	029	. .	044	. .
Ni	2	3	. .	⊙′	6772	. .	569	. .	. .	566	570	. .	560	567	570	561	. .	555	. .	. .	. .	567	. .	565	. .
Fe	. .	1	. .	⊙	6787	. .	. .	. .	. .	123	. .	154	157	. .	. .	. .	. .	. .	. .	. .	. .	116	. .	137	. .
Fe	. .	2	. .	⊙′	6807	. .	. .	. .	. .	. .	. .	. .	115	080	095	107	. .	. .	. .	. .	. .	103	. .	100	. .
Fe	. .	3	. .	⊙″	6810	. .	. .	. .	. .	517	523	. .	524	521	520	510	. .	. .	. .	. .	. .	521	. .	519	. .
Fe	. .	2	. .	⊙′	6820	. .	. .	. .	. .	613	. .	. .	610	601	. .	. .	. .	. .	. .	. .	. .	631	. .	614	. .
Fe	. .	2	. .	⊙′	6828	. .	. .	. .	. .	841	851	878	847	831	. .	. .	. .	. .	. .	. .	. .	851	. .	850	. .
Fe	. .	3	. .	⊙′	6841	. .	. .	. .	. .	598	593	. .	610	560	. .	. .	. .	. .	. .	. .	. .	596	. .	591	. .
Fe	. .	3	. .	⊙′	6843	. .	. .	. .	. .	908	. .	. .	900	909	. .	. .	. .	. .	. .	. .	. .	914	. .	908	. .
Fe	. .	3	. .	⊙′	6855	. .	. .	. .	. .	420	428	442	440	412	. .	. .	388	. .	. .	. .	. .	443	426	425	. .

* Companion near to violet.

	Intensity in Arc	Intensity in Sun	Kind of Standard		St	St	u	p	q	O	C	R	h	i	C′	t	Pl 22	Pl 23	Mean
							⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	J c ⊙	J c ⊙	⊙
A	. . .	3	⊙′	6867	. .	. .	. .	435	. .	501	447	460	476	461	455	468	468	443	461
A	. .	3	⊙′	6867	. .	. .	. .	748	. .	837	771	795	796	785	825	799	832	818	800
A	. .	1	. .	6868	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	152	096	124
A	. .	d 6	. .	6868	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	393	393	393
A	. .	d {1 3}	. .	6868	. .	. .	. .	. .	. .	. .	744	. .	. .	. .	. .	. .	786	808	779
A	. .	4	. .	6869	. .	. .	. .	. .	. .	. .	111	. .	. .	. .	161	. .	145	149	141
			⊙′		. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
A	. .	4	. .	6869	. .	. .	. .	. .	. .	. .	317	. .	. .	. .	369	. .	351	350	347
A	. .	d {4 4}	⊙″	6870*	. .	. .	. .	196	209	185	160	201	. .	. .	157	194	186	189	186
A	. .	5	⊙′	6871	. .	. .	. .	. .	. .	. .	175	. .	. .	. .	192	. .	176	173	179
A	. .	5	⊙′	6871	. .	. .	. .	. .	. .	. .	486	. .	. .	. .	540	. .	538	544	527
A	. .	5	⊙″	6872	. .	. .	. .	. .	. .	. .	479	. .	. .	. .	528	. .	481	485	493
A	. .	5	⊙″	6873	. .	. .	. .	. .	. .	. .	050	. .	. .	. .	. .	. .	088	090	076
A	. .	5	⊙″	6874	. .	. .	. .	. .	. .	. .	021	. .	. .	. .	050	. .	040	044	039
A	. .	5	⊙″	6874	. .	. .	. .	. .	. .	. .	870	. .	. .	. .	876	. .	892	900	884
A	. .	5	⊙″	6875	. .	. .	. .	826	826	. .	819	. .	800	. .	843	835	824	836	826
A	. .	5	⊙″	6876	. .	. .	. .	. .	. .	. .	942	. .	960	. .	972	955	956	959	957
A	. .	5	⊙″	6877	. .	. .	. .	. .	. .	. .	865	. .	879	. .	882	872	884	887	878
A	. .	5	⊙″	6879	. .	. .	. .	297	. .	297	269	312	291	306	307	286	291	281	294
A	. .	3	⊙″	6880	. .	. .	. .	174	. .	187	150	191	160	224	154	160	177	177	176
Cr	1	1	. .	6881	. .	. .	. .	. .	. .	. .	932	. .	. .	. .	973	. .	991	984	970
Cr	2	1	. .	6882	. .	. .	. .	. .	. .	. .	755	. .	. .	. .	753	. .	796	783	772
Cr	3	1	. .	6883	. .	. .	. .	. .	. .	. .	327	. .	. .	. .	294	. .	335	317	318
A	. .	4	⊙″	6884	. .	. .	102	084	076	090	046	113	068	085	098	078	080	080	083
A	. .	5	⊙″	6886†	. .	. .	. .	002	. .	013	000	015	995	032	018	994	002	006	008
A	. .	5	⊙″	6886	. .	. .	. .	983	. .	001	972	017	974	980	988	971	989	991	987
A	. .	5	⊙″	6889	. .	. .	. .	. .	. .	. .	175	. .	. .	. .	224	. .	191	188	194
A	. .	5	⊙″	6890	. .	. .	. .	. .	. .	. .	136	. .	. .	. .	138	. .	144	151	149
A	. .	6	⊙″	6892	. .	. .	. .	. .	. .	. .	595	. .	. .	. .	629	. .	615	617	614
A	. .	6	⊙″	6893	. .	. .	. .	. .	. .	. .	537	. .	. .	. .	567	. .	564	570	559
A	. .	6	⊙″	6896	. .	. .	. .	. .	. .	307	274	. .	. .	. .	301	284	294	290	292
A	. .	6	⊙″	6897	. .	. .	. .	147	. .	226	183	. .	. .	. .	195	198	203	214	195
A	. .	6	⊙″	6900	. .	. .	. .	. .	. .	. .	182	. .	. .	. .	205	111	200	199	199
A	. .	6	⊙″	6901	. .	. .	. .	127	099	120	093	. .	. .	. .	106	. .	115	119	113

* Principal line in the head of B.

† First line in the tail of B.

	Intensity in Arc	Intensity in Sun	Kind of Standard		St	St	u	p	q	o	C	R	h	i	C′	t	Pl 22	Pl 23	Mean
							⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
A	. .	6	⊙″	6904	. .	. .	. .	. .	. .	. .	340	. .	. .	. .	378	. .	359	357	358
A	. .	6	⊙″	6905	. .	. .	. .	. .	. .	. .	255	. .	. .	. .	255	. .	274	269	263
A	. .	6	⊙″	6908	. .	. .	. .	. .	. .	. .	777	. .	. .	. .	791	. .	789	782	785
A	. .	6	⊙″	6909*	. .	. .	. .	668	683	689	661	. .	. .	. .	675	672	674	674	675
A	. .	5	⊙″	6913	. .	. .	. .	. .	. .	. .	436	. .	. .	. .	484	. .	449	446	454
A	. .	5	⊙″	6914	. .	. .	. .	. .	. .	. .	310	. .	. .	. .	. .	. .	338	337	328
Ni	5	3	⊙′	6914	. .	. .	. .	. .	. .	. .	806	. .	. .	. .	. .	. .	826	825	819
	. .	2	⊙′	6916	. .	. .	. .	. .	. .	. .	948	. .	. .	. .	981	. .	950	950	957
A	. .	4	⊙″	6918	. .	. .	. .	. .	. .	. .	356	. .	. .	. .	359	. .	371	366	363
A	. .	4	⊙″	6919*	. .	. .	. .	243	238	258	245	. .	. .	. .	241	237	250	244	245
A	. .	4	⊙″	6923*	. .	. .	. .	. .	. .	. .	533	563	564	. .	568	562	558	554	557
A	. .	4	⊙″	6924*	. .	. .	. .	423	418	421	417	432	399	. .	407	425	426	427	420
A	. .	2	⊙′	6928	. .	. .	. .	. .	. .	. .	947	. .	. .	. .	066	. .	982	974	992
A	. .	2	⊙′	6929	. .	. .	. .	870	868	. .	827	. .	. .	. .	802	827	836	833	838
A	. .	1	. .	6934	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	593	. .	680	666	646
A	. .	1	. .	6935	. .	. .	. .	. .	. .	. .	517	. .	. .	. .	551	. .	524	528	530
Awv	. .	7	⊙″	6947	. .	. .	. .	794	768	. .	772	797	781	753	786	. .	797	799	781
Awv	. .	d{1, 1	. .	6953	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	903	. .	798	813	838
Awv	. .	7	⊙″	6956	. .	. .	730	684	706	731	688	705	693	694	693	. .	692	681	700
Awv	. .	3	. .	6959	. .	. .	. .	711	. .	731	704	701	704	709	705	. .	698	705	708
Awv	. .	6	. .	6961	. .	. .	554	515	501	529	520	519	511	515	505	. .	506	527	518
Awv	. .	. .	. .	6977	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	723	723
Awv	. .	2	. .	6978	. .	. .	. .	648	687	. .	655	625	. .	. .	. .	. .	. .	662	655
Awv	. .	6	. .	6986	. .	. .	. .	835	836	847	816	842	818	828	849	. .	. .	811	832
Awv	. .	6	. .	6989	. .	. .	. .	. .	. .	. .	228	265	239	237	241	. .	. .	232	240
Awv?	. .	. .	. .	6998	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	953	953
At?	. .	6	. .	6999	. .	. .	. .	177	. .	. .	186	. .	150	145	163	. .	. .	222	174
Awv	. .	6	. .	7000	. .	. .	. .	. .	. .	. .	139	140	. .	. .	. .	. .	. .	151	143
	. .	7	. .	7006	. .	. .	. .	138	164	. .	193	. .	. .	. .	143	. .	. .	159	160
Awv	. .	3	. .	7011	. .	. .	. .	567	. .	578	594	595	. .	. .	573	. .	. .	603	585
	. .	3	. .	7016	. .	. .	. .	. .	. .	. .	. .	275	249	283	285	. .	. .	304	279
	. .	8	. .	7016	. .	695	. .	672	693	. .	677	699	698	697	695	. .	. .	674	690
	. .	. .	. .	7023	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	225	225
Awv	. .	3	. .	7023	747	750	. .	. .	. .	. .	728	743	769	. .	745	. .	. .	748	747
	. .	3	. .	7024	. .	. .	. .	992	. .	. .	. .	. .	. .	. .	983	. .	. .	. .	988
	. .	. .	. .	7027	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	199	199
	. .	5	. .	7027	724	718	760	713	. .	. .	724	725	708	. .	706	. .	. .	748	726

* These lines were used as substandards for t.

	Intensity in Arc	Intensity in Sun	Kind of Standard		St	St	u ⊙	p ⊙	q ⊙	o ⊙	C ⊙	R ⊙	h ⊙	i ⊙	C′ ⊙	l′ ⊙	Pl 22 J c ⊙	Pl 23 J c ⊙	Mean ⊙
	. .	3	. .	7035	. .	162	. .	167	166	145	180	130	137	. .	180	. .	. .	168	159
	. .	2	. .	7038	. .	469	. .	483	. .	. .	. .	428	455	. .	488	. .	. .	496	470
	. .	5	. .	7040	056	060	067	060	. .	065	061	057	068	. .	046	. .	. .	041	058
Awv	. .	3	. .	7090	. .	. .	. .	. .	. .	. .	661	635	674	. .	616	. .	. .	638	645
	. .	6	. .	7122	. .	. .	. .	. .	. .	. .	513	468	497	. .	535	. .	. .	444	491
Awv	. .	1	. .	7147	. .	. .	. .	. .	. .	. .	921	924	964	. .	958	. .	. .	. .	942
	. .	7	. .	7148	. .	. .	. .	. .	. .	. .	457	417	416	. .	. .	. .	. .	417	427
	. .	7	. .	7168	. .	. .	. .	. .	. .	. .	178	181	209	. .	242	. .	. .	143	191
Awv	. .	d, 3	. .	7176	. .	. .	. .	. .	. .	. .	370	332	366	371	361	. .	. .	292	347
	. .	17	. .	7184	. .	800*	. .	. .	. .	. .	788	798	763	804	778	. .	. .	757	781
Awv	. .	d, 6	. .	7186	. .	. .	. .	. .	. .	. .	581	549	567	550	566	. .	. .	497	552
Awv	. .	d, 3	. .	7193	. .	. .	. .	. .	. .	. .	. .	916	. .	913	. .	. .	. .	935	921
Awv	. .	d, 10	. .	7200	. .	. .	. .	. .	. .	. .	765	742	759	. .	767	. .	. .	734	753
Awv	. .	10	. .	7201	. .	. .	. .	. .	. .	. .	468	454	504	. .	486	. .	. .	434	468
Awv	. .	6	. .	7216	. .	806*	. .	. .	. .	. .	827	. .	782	. .	834	. .	. .	. .	812
Awv	. .	8	. .	7223	. .	930*	. .	. .	. .	. .	927	. .	919	942	930	. .	. .	. .	930
	. .	6	. .	7227	. .	753*	. .	. .	. .	. .	736	. .	775	. .	797	. .	. .	. .	765
Awv	. .	3	. .	7232	. .	. .	. .	. .	. .	. .	489	. .	510	. .	529	. .	. .	. .	509
Awv	. .	8	. .	7233	. .	179*	. .	. .	. .	. .	184	. .	195†	. .	124	. .	. .	. .	171
Awv	. .	d, 4	. .	7240	. .	981*	. .	. .	. .	. .	980	. .	997	957	946	. .	. .	. .	972
Awv	. .	d, 15	. .	7243	. .	. .	. .	. .	. .	. .	911	. .	903	905	898	. .	. .	. .	904
Awv	. .	4	. .	7247	. .	. .	. .	. .	. .	. .	440	. .	. .	. .	481	. .	. .	. .	461
Awv	. .	8	. .	7264	. .	. .	. .	. .	. .	. .	836	. .	870	. .	848	. .	. .	. .	851
Awv	. .	8	. .	7265	. .	. .	. .	. .	. .	. .	750	. .	850	. .	888	. .	. .	. .	833
Awv	. .	d, 3	. .	7270	. .	. .	. .	. .	. .	. .	188	. .	. .	. .	221	. .	. .	. .	205
	. .	8	. .	7273	. .	. .	. .	. .	. .	. .	270	. .	239	247	267	. .	. .	. .	256
	. .	. .	. .	7275	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	675	. .	. .	. .	675
Awv	. .	6	. .	7287	. .	. .	. .	. .	. .	. .	684	. .	697	. .	686	. .	. .	. .	689
	. .	10	. .	7290	. .	. .	. .	. .	. .	. .	719	. .	735	728	675	. .	. .	. .	714
	. .	d, 4	. .	7300	. .	. .	. .	. .	. .	. .	961	. .	132	075	. .	. .	. .	. .	056
Awv	. .	7	. .	7304	. .	. .	. .	. .	. .	. .	476	. .	517	465	442	. .	. .	. .	475
Awv	. .	5	. .	7318	. .	. .	. .	. .	. .	. .	778	. .	777	802	916	. .	. .	. .	818
	. .	2	. .	7321	. .	. .	. .	. .	. .	. .	058	. .	. .	050	060	. .	. .	. .	056
	. .	2	. .	7331	. .	. .	. .	. .	. .	. .	195	. .	215	. .	209	. .	. .	. .	206
	. .	2	. .	7335	. .	. .	. .	. .	. .	. .	. .	. .	648	. .	659	. .	. .	. .	654
	. .	. .	. .	7389	. .	. .	. .	. .	. .	. .	. .	. .	. .	719	672	. .	. .	. .	696

* From 4823.690 and 4824.325.

† The lines 4823, 4824, and 4860 were observed in the third spectrum and used as standards.

	Intensity in Arc	Intensity in Sun.	Kind of Standard		St	St	u	p	q	o	C	R	h	l	C′	l′	Pl 22	Pl 23	Mean
							⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	J/c ⊙	J/c ⊙	⊙
	. .	. .	. .	7409	. .	. .	. .	. .	. .	. .	. .	. .	. .	578	530	. .	. .	. .	554
	. .	6	. .	7446	. .	. .	. .	. .	. .	. .	. .	. .	057	042	014	. .	. .	. .	038
	. .	. .	. .	7462	. .	. .	. .	. .	. .	. .	. .	. .	. .	619	599	. .	. .	. .	609
	. .	6	. .	7495	. .	. .	. .	. .	. .	. .	. .	. .	371	335	348	. .	. .	. .	351
	. .	6	. .	7511	. .	. .	. .	. .	. .	. .	. .	. .	310	272	275	. .	. .	. .	286
	. .	. .	. .	7545	. .	. .	. .	. .	. .	. .	. .	. .	921	. .	. .	. .	. .	. .	921
Awv	. .	. .	. .	7594*	. .	. .	. .	. .	. .	. .	. .	. .	113	023	053	047	. .	. .	059
Awv	. .	10	. .	7621†	278	. .	. .	. .	. .	. .	. .	. .	272	279	278	279	. .	. .	277
Awv	. .	7	. .	7623	. .	. .	. .	. .	. .	. .	. .	. .	498	525	560	522	. .	. .	526
Awv	. .	7	. .	7624	. .	. .	. .	. .	. .	. .	. .	. .	837	812	820	903	. .	. .	858
Awv	. .	7	. .	7627	. .	. .	. .	. .	. .	. .	. .	. .	342	. .	244	111	. .	. .	232
Awv	. .	7	. .	7628	. .	. .	. .	. .	. .	. .	. .	. .	689	. .	570	496	. .	. .	585
Awv	. .	7	. .	7659	. .	. .	. .	. .	. .	. .	. .	. .	. .	643	666	666	. .	. .	658
Awv	. .	6	. .	7660	. .	. .	. .	. .	. .	. .	. .	. .	. .	772	781	781	. .	. .	778
Awv	. .	6	. .	7665	. .	. .	. .		. .	. .	. .	. .	. .	296	307	191	. .	. .	265
Awv	. .	5	. .	7666	. .	. .	. .	. .	. .	. .	. .	. .	. .	256	291	171	. .	. .	239
Awv	. .	4	. .	7670	. .	. .	. .	. .	. .	. .	. .	. .	. .	006	995	977	. .	. .	993
Awv	. .	4	. .	7671	. .	. .	. .	. .	. .	. .	. .	. .	. .	007	999	977	. .	. .	994
Awv	. .	4	. .	7699	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	374	. .	. .	. .	374
	. .	2	. .	7714	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	686	. .	. .	. .	686

* Beginning of the head of A, outside edge.

† Single line between the head and tail of A.

Remarks, Critical and Otherwise.

In looking over this paper, the following thought occurred to me of a critical nature. First, it is to be noted that the observations have extended over ten years, and have many of them been made for other purposes than for the use here made of them. Hence the paper seems to lack unity of purpose, as many of the standards were added after the observations had begun, and do not appear in the earlier series. But it must be remembered that no good map of the spectrum existed at the time they were commenced, and I had no means of avoiding poor standards and selecting the best, such as I might do at present. To retain the old observations I was thus obliged to retain many poor standards. Again, for the method of coincidences only poor standards may exist in the limited region where the measurements were made.

The effect of all this is to make many gaps in the table. But many of the gaps also come from other causes which could not be avoided.

The series of metallic plates was primarily made for measuring the spectra of metals. It is unfortunate for the present use that they nearly all begun and ended at the same place, overlapping very little. However, I have nearly always measured one or more plates to fill in the gap, and the coincidence of the values on these with the others shows that no error has been committed. Indeed, the accuracy with which the parts of this patchwork table fit into one another gives more confidence to me than if it had been made up of regular parts designed for their purpose.

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III.

CONTRIBUTION TOWARDS A MONOGRAPH

OF THE

LABOULBENIACEÆ.

BY

ROLAND THAXTER.

Mo. Bot. Garden,
1897.

Presented May 8, 1895.

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INTRODUCTORY NOTE.

In the fourth volume of the "Memoirs of the Boston Society of Natural History" (No. VI, April, 1888), the writer published an account of the American forms belonging to the family of Entomophthoreæ, with notes on all the species then known, which was intended to form the first of a series designed to include all the American fungi parasitic on insects. The subject was suggested to me by Professor Farlow, while I was a student in his laboratory, as one promising data of sufficient interest to furnish material for a doctor's thesis. The Entomophthoreæ, however, having proved adequate in themselves to fulfil this requirement, the remaining entomogenous forms were laid aside in the hope that, at some future time, the original plan of a complete monograph might be carried out. In the paper just mentioned, a brief summary was given of all the fungi characterized by this peculiar parasitism; and, in addition to the family of Entomophthoreæ, several groups were in a general way distinguished. Of these one comprises the entophytic and probably commensalist Schizomycetes (?) represented by the genus Enterobrus and its allies, to which might be added certain lower forms of the same order supposed to give rise to contagious diseases among insects; a second includes the perfect and imperfect or "isarial" conditions of the entomogenous species of the genus Cordyceps and its allies; while a third embraces all the members of the then small and little known family of Laboulbeniaceæ. To these should be added a few miscellaneous forms parasitic on insects; and perhaps, also, such fungi as are found in nature only on the remains or excreta of certain insects. The last, however, since they are saprophytic, cannot be called entomogenous in the more strict sense of the term.

Since the completion of the monograph above mentioned, I have accumulated material of entomogenous fungi whenever the opportunity has offered, but have found the number of forms so unexpectedly large that, as in the former instance, it has become necessary to abandon my plan of completing a monograph of all the remaining groups in a single paper. In view of this fact, the Laboulbeniaceæ have been selected as the subject of the present memoir, since they include by far the greater portion of the material referred to.

At the time when my attention was first attracted to the Laboulbeniaceæ by the discovery of several new species in the vicinity of New Haven, Connecticut, during the summer of 1890, it included six described genera (two of which have proved to be synonyms), represented by fifteen described species of which one only was from North America; while, of the remaining forms, two were from South America and the rest from Europe. To these, however, European writers have since added a single species, while my own observations have served very considerably to increase the total number of forms referable to this family. A greater portion of these additions have already been described in a series of papers which have appeared from time to time during the past few years in the "Proceedings" of the Academy, and serve as a systematic basis for the present monograph, in which will be found enumerated more than one hundred and fifty species from various parts of the world, distributed among twenty-eight genera. The labor and time involved in obtaining and studying the several thousand specimens which have been examined in the preparation of this paper and of the accompanying plates, can hardly be appreciated by any one who has not had personal experience of the many difficulties associated with the manipulation and study of these, for the most part, very minute plants. It is, therefore, needless to say that my investigations, carried on as they have been in connection with other occupations, are incomplete and unsatisfactory in many points relating to the structure and development of certain genera, for the proper study of which sufficient time or material, or both, have not been available; and although a certain amount has been done in connection with the nuclear changes which take place in the sexual organs before and after fertilization, I have been unable, as yet, to reach conclusions concerning them sufficiently definite to warrant their publication. The results obtained, however, although in very many respects imperfect, have served to demonstrate the unlooked-for numerical importance of the group, its great diversity, and, above all, have afforded definite information concerning the course of development of its members, as a result of which their pivotal position among the higher fungi is clearly indicated.

Of the species enumerated, more than half have been collected in New England by myself and studied while still living, the remainder having been derived from the examination of dead insects in the collections to which I have had access, or from insects sent in alcohol by numerous correspondents to whose kindness I owe very many interesting forms. For such favors I am under special obligations to Miss A. M. Parker, who has sent me many specimens of Carabidæ from Washington; to Prof. O. F. Cook, who has placed at my disposal all the Coleoptera collected by him in Liberia; to Mr. Theodore Pergande for many interesting specimens collected in or

near the District of Columbia; to Prof. Alfred Giard for the communication of several important specimens as well as references to literature; while the Rev. J. L. Zabriskie, Mr. M. A. Barber, Dr. H. M. Richards, Mr. J. M. Aldrich, Mr. William Beutenmueller, Prof. S. A. Forbes and Dr. G. von Istvanffi have also greatly assisted me by the communication of numerous specimens. I am also indebted to the kindness of Miss Helen Bondy, of Vienna, for a large number of house-flies collected in that city, from which were derived the important series of specimens of *Stigmatomyces Baeri* illustrated on Plate I. Special acknowledgment is, moreover, due to Mr. Samuel Henshaw, to whom I am indebted for the determination of the host insects, as well as for the privilege of free access to the collections under his charge, including the type collection of the late Dr. Leconte.

In making these acknowledgments, I may add that it is my intention to continue my studies of insect fungi as my opportunities permit; and that the communication of further material from correspondents, especially of Laboulbeniaceæ, will be greatly appreciated. I may also add the hope that, the family being placed with the publication of the present monograph on a moderately intelligible basis, from a systematic standpoint; it may not, like the other groups of entomogenous fungi, be reduced to a condition of chaos through the indiscriminate publication of new forms based largely on the character of the host or on its habitat; since, as we shall presently see, these are but uncertain guides in recognizing the species.

Cryptogamic Laboratory of Harvard University,
Cambridge, June, 1896.

MONOGRAPH OF THE LABOULBENIACEÆ.

PRESENTED MAY 8, 1895.

PART I.

In the first part of this Memoir I have given an account of the History, Distribution, General Morphology and Development, Hosts, etc., of the Laboulbeniaceæ; while the second part comprises a systematic examination of the species and genera illustrating the family. Before entering, however, on the detailed consideration of the topics mentioned, it has seemed desirable, by way of introduction, to present a brief account of the more general characters of these plants.

Unlike the majority of fungi which subsist as parasites of living insects, the present group includes none of the conspicuous productions that are so characteristic among entomogenous fungi generally; and their usually minute size doubtless accounts, in some degree, for the fact that, although they are in certain respects among the most important of fungus organisms, they have been so long neglected by botanists and so generally overlooked or disregarded by entomologists. When examined *in situ* on the host insect, they appear in general like minute, usually dark-colored or yellowish bristles or bushy hairs, projecting from its chitinous integument either singly or in pairs, more commonly scattered, but often densely crowded over certain areas on which they form a furry coating. Unlike other entomogenous fungi also, the Laboulbeniaceæ can lay no claim to economic importance; and although they may be said to produce a contagious cutaneous disease, they give rise to none of the fatal epidemics which are liable to be associated with the parasitism of species of Cordyceps and Entomophthora. On the contrary, the very existence of these parasites would seem to be dependent on the fact that the host is not destroyed by their attack; since their own life ends with that of the insect to which they are attached, and their perpetuation from generation to generation and from year to year is undoubtedly dependent on the direct transference from one living insect to another of their reproductive bodies. So far, then, as they are at present known, they inflict

little if any appreciable injury on the host, and even when the latter is completely covered by them it shows no more marked signs of injury than is indicated by a greater restlessness, owing perhaps to a slight irritation which they may be supposed to produce. This absence of appreciable injury, associated as it is with true parasitism, is due to the fact that the habit of growth of the plants in question is an external one, unassociated, except in rare instances, with any penetration of well-developed haustoria into the body cavity, the parasite in almost all cases deriving its nourishment through at most a slight perforation of the host's integument. The hosts affected are all comparatively long-lived hibernating insects, and more or less continuous feeders; and in the present, as in so many other instances, are obliged to become the unwilling medium for the nutrition of an often numerous and varied population from which they are freed only by death.

An external parasitism, like that of the plants in question, on hosts living and as a rule actively locomotive, whether in water, in the air, or on the ground, would naturally be associated with a comparatively simple structure adapted to the exigencies of such a life; and a glance at the accompanying plates will show that such a simple type form may be traced in a general way throughout the group. A main body, or receptacle, is fixed by means of a blackened base, or foot, to the integument of the host, and consists in most cases of a very small number of cells differently arranged in different genera. This receptacle gives rise above to certain peculiar appendages of very variable form, commonly connected with the production of the male sexual organs; while from the same individual, with few exceptions in which the plants are diœcious, female organs are also variously produced from which perithecia are eventually developed. In the perithecia, which may arise singly or in considerable numbers from a given individual, and which are quite remarkable in structure, are produced the reproductive bodies or ascospores that are formed in asci identical in all respects with the organs thus named in other members of the great group of ascomycetous fungi. The ascospores thus formed germinate on the surface of the host to which they become attached by a blackened modification of their basal extremity, and, without the formation of any hyphæ, grow directly to new individuals by means of successive cell divisions. In respect to size the mature individuals vary considerably within certain rather narrow limits, for while the smallest species measure somewhat less than one-tenth of a millimeter in total length, a very few exceed a millimeter from base to tip, while by far the greater number do not attain more than half this length. Within the limits of size and fundamental structure just described, the opportunities for eccentricity of form seem, however, to have been abundantly utilized,

and the modifications which they present are so singular that the members of the group may well rank among the most remarkable of vegetable productions.

It is not to their variety and eccentricity of form, however, that they owe their special claim to interest and importance among plants in general and fungi in particular; but to the fact that, associated with their comparatively simple vegetative development, they present sexual phenomena the complicated nature of which would indicate that they occupy a position among the highest members of their class. It is hardly necessary to remark that any fresh evidence in this connection has a special interest at the present time; since, as a result of the views so strenuously maintained by Professor Brefeld and his school, the existence of sexuality of any type among the higher fungi, has become, to say the least, discredited by a majority of the mycologists of the present day. If we are to admit nevertheless, as seems quite unavoidable, that the Laboulbeniaceæ are fungi, and also, as seems equally unavoidable, that they are ascomycetous fungi in the strict sense of the term, it must also be admitted that they demonstrate the sexual origin of the ascus beyond any reasonable doubt. However views may differ as to the true phyllogeny of the group as a whole, the most devout disciple of the so-called "school" of De Bary could hardly have devised a series of forms better adapted than the present family to confirm his general conclusions. Despite this fact, one looks, as a rule, in vain for even a reference to the Laboulbeniaceæ in the host of text-books which have made their appearance within the past few years, while in the works of Professor Brefeld, so far as I have been able to ascertain, they are not even mentioned by name.

Further discussion of these matters may well be deferred, however, until the morphology of the more important genera has been considered, and with this brief note and general affirmation of my own views in regard to the vexed question of sexuality among the ascomycetes, we may turn at once to consider the family in detail.

Historical. In reviewing the literature relating to the Laboulbeniaceæ it will be noted that, although the list of titles is not a short one, a considerable number have reference either to brief notes or to articles which deal at second hand with previously published data, while the original contributions are comparatively few. A complete list of references, so far as I have been able to obtain them, will be found appended; but in briefly tracing the history of the family in so far as its literature is concerned, I shall omit reference to such articles as are not in the nature of contributions to a knowledge of the group.

This knowledge may be said to have originated with the publication by Robin of

his classic "Histoire Naturelle des Végétaux Parasites," in which, for the first time, the vegetable nature of these organisms was recognized. In this work two species are enumerated, for the reception of which the new genus *Laboulbenia* Montagne et C. Robin (e familia Pyrenomycetum novum genus) was erected; the generic name being selected in honor of the entomologist Laboulbène, who was, perhaps, the first to observe the *L. Rougetii* of these authors, which occurs on species of *Brachinus* in Europe. The second form, *L. Guerinii*, was obtained from a South American species of the aquatic genus *Gyretes*, and both are figured and described at considerable length. Although the spores are described, no mention is made of their origin; while the perithecia are spoken of as sporangia. It is, therefore, somewhat uncertain what this author's views really were in regard to the position and relation of the forms described, although the comment "Genus sphæriaceum, maxime singulare, entomogenum, quoad perithecium Capnodio analogum" would lead one to suppose that it was thought to be ascigerous.

Robin's materials were received in part, however, from the entomologist Rouget, to whom belongs the credit of the first published note on these parasites, which, as early as 1850, three years before the publication of Robin, he had described and figured in the "Annales de la Société Entomologique de France," under the title "Note sur une production parasite observé sur le *Brachinus crepitans*." He did not, however, recognize the true character of the organisms described, nor did he distinguish several different species which he must have had before him, if one may judge from the diversity of the hosts on which he states that he had observed this "production parasite." It may be mentioned also that in 1852 still another species of Laboulbenia was observed by Mayr, the *L. Nebriæ* described many years after by Peyritsch, and was supposed by him to be a pathological condition of the insects chitinous integument.

During the next sixteen years little of importance was published concerning the group; but it is of interest to note that Prof. H. A. Hagen, in his well-known monograph of the Termites, mentions that he had observed on the larva of a worker of *Termes bellicosus* a Laboulbenia closely resembling the *L. Guerinii* of Robin, concerning which a further note will be found in connection with the subsequently described *L. Hageni*. In 1857 also, Kolenati, in a paper entitled "Epizoa der Nycteribien," described certain parasites on these wingless flies, which infest various species of bats, placing them among the worms in a new genus to which he gave the name *Arthrorhynchus*, including two supposed species, *A. Diesingii* and *A. Westrumbii*. Two years later (1859) Diesing, in his "Revision der Rhyngoden," made these two forms the types of a new tribe of Vermes, the *Arthrorhyngodeæ*, characterized by a quite

astonishing zoölogical anatomy. The same genus, it may be mentioned, was subsequently rechristened *Helminthophana* by Peyritsch, who placed it in its proper kingdom and family, its connection with the Laboulbeniaceæ having been previously pointed out by Brauer (1871).

In 1868 an important addition to the family was made by Knoch (1868), who described as *Laboulbenia Bæri* the interesting form, redescribed in the succeeding year by H. Karsten (1869) as *Stigmatomyces muscæ*, which occurs in middle and western Europe on the common house-fly. The paper of Karsten owes its importance to the fact that this writer was the first to recognize the presence of a highly developed type of sexuality in these plants, and although the account given is largely incorrect as to the details of morphology and development, the important fact of the existence of a trichogyne fertilized by antherozoids is distinctly emphasized and rightly compared to the similar conditions present in the Florideæ. The use by this writer of such terms as "archegonium" render it uncertain what his opinion as to the true position of the plant was at this time. In a later work (1895) the same writer includes all the Laboulbeniaceæ in a group of "Stigmatomycetes," placed between the Ustilagineæ and the Pyrenomycetes. The same form, it may be mentioned, was redescribed in 1872 by Sorokin as *Laboulbenia muscæ*.

With the exception of a note by Robin in his "Traité du Microscope," where he figures *Rhachomyces pilosellus* (Robin) Thaxter, no further contributions of importance are met with until the publication by Peyritsch of the first of his well-known papers on the family (1871), in which he describes and figures the "*Laboulbenia Bæri*" of Knoch already referred to, as well as the Arthrorhynchus of Kolenati, discarding the generic and specific names given by this writer, and designating the species as "*Laboulbenia Nycterybiæ*." In this paper the existence of asci was somewhat doubtfully made out; but the sexual process described by Karsten was not observed. A new form, *Laboulbenia Nebriæ*, was also described and figured.

Two years later (1873) a second paper by the same author made its appearance, in which several new species and genera were described and figured, and a synopsis of the whole family appended. In this paper the author for the first time recognizes in a measure the grounds which have proved to be the determining factors in connection with generic distinctions in the group. The forms enumerated are twelve in number, distributed among five genera, one of which must now be regarded as a synonym. The general morphology and development is described, in so far as it was then understood; but not without many inaccuracies, the sexual processes being undetermined, except in so far as concerns the existence of a trichogyne, which was

observed and figured in several instances. The developmental relations between the appendage perithecium and receptacle were accurately made out in connection with the two genera Laboulbenia and Stigmatomyces, and the origin of the asci as buds from some central cell was suggested. The asci were not, however, accurately observed. A third paper by Peyritsch, published in 1875, contains additional notes on the development and occurrence of the Laboulbeniaceæ, without, however, making any essential contribution to previously published data. In none of the papers of this writer are the characters of the male organs determined, and he seems to incline to the opinion that the latter are represented by the shorter branches of the appendages, which he regarded as pollinodia and supposed to conjugate with the trichogyne.

Following these publications of Peyritsch, we have in 1884 the suggestive summary by De Bary of the characters of the group so far as then known in the "Doubtful Ascomycetes" of his Morphology and Biology of the Fungi, etc. In 1886 occurs the note of Gerke, to which my attention was drawn through the kindness of Professor Giard, in which he gives a figure that, without doubt, is intended to represent the "*Appendicularia entomophila*" of Peck, published two years later. In the same year (1886), Karsten published in Hedwigia, under the title "Doubtful Ascomycetes," a reassertion of his former observations on the sexuality of Stigmatomyces, in reply to the publications of Peyritsch and De Bary already mentioned, denying their ascomycetous nature and giving what he supposed to be the method by which the spores were formed.

In 1889, Berlese again summarized the group, adding to the thirteen species then known a new form (*Laboulbenia armillaris*) found on an acarid from South America. With the exception of the writer's own notes on the family, but two papers published since the one just mentioned remain to be noticed: that of Giard (1892), in which he describes, as a new genus Thaxteria, a remarkable species of Laboulbenia from the Javan Mormolyce; and that of Istvanffi (1895), in which he redescribes as *Laboulbenia gigantea* a large form of *L. elongata*, giving his impressions of its morphology and development, stating his disbelief in the sexuality of the group, and expressing the erroneous opinion that the individuals are derived from a vegetative portion growing within the body cavity of the insect.

General Morphology and Development.

Spores. The spores of the Laboulbeniaceæ present a uniformity of form and structure quite remarkable for so varied a group, being in all cases, without exception, hyaline and fusiform or acicular in shape; and although in the single genus

Amorphomyces they are continuous (Plate V, fig. 29), in all others they are divided into two cells by a septum or pseudoseptum. In the great majority of cases the two spore segments are of unequal size; that which is terminal in relation to the axis of growth being, as a rule, much the longest: although in a few cases, as in Zodiomyces and Ceratomyces (Plates XXIV to XXVI), the reverse is true; while in still other instances the septum may be more nearly median, as in Compsomyces (Plate XI, fig. 15). The spore contents usually consists of more or less homogeneous granular protoplasm, except in the genus Amorphomyces, the spores of which when living contain numerous, often large, oil globules. In all cases a large spherical nucleus may be, as a rule, readily demonstrated in either segment (Plate I, fig. 13). A gelatinous envelope, more or less well developed and characteristically thickened about its base, always surrounds the spore; serving as a protective covering for the latter as well as facilitating its adherence to the host insect when it comes in contact with its surface. In the majority of cases this envelope, though often adherent about the tip of the spore, is continuous around it; but in *Ceratomyces furcatus* and *C. contortus* (Plate XXV, figs. 4 and 10) the separation between the spore segments involves the envelope also, which is marked by a corresponding constriction.

The spores are produced in the asci in fours or eights (Plate XXIV, fig. 9, Plate XI, fig. 17), in the first instance usually disposed more or less definitely in pairs, one of which is slightly higher than the other; and the members of a given spore pair are discharged together through the pore of the perithecium, the ascus wall having been previously absorbed. The juxtaposition of two individuals at the point of contact with the host, a condition essential for the perpetuation of the diœcious species, is thus insured in a majority of cases (Plate III, fig. 5). The spores are formed in the ascus, and therefore lie in the cavity of the perithecium after the wall of the latter has been absorbed, with the basal half uppermost; and the base is therefore directed towards the substratum on which it is discharged. Having become attached to a proper host, the swollen portion about the base, by its peculiar form, assists the spore in assuming the position necessary for germination; the upper extremity, if at first adherent, soon freeing itself and projecting from the substratum at an acute angle. A conspicuous exception to the conditions just described is found in the genus Moschomyces, the minute spores of which are irregularly distichous in the eight-spored ascus, and become free in a mass within the distal portion of the perithecium, whence they are discharged, not in pairs but in small masses, each mass probably giving rise to the so-called individual, which may thus in reality be compound (Plate XI, figs. 16 and 18).

The transfer of the spores from one host to another is probably accomplished, as a rule, by the direct contact of two insects; as, for example, during coitus, perhaps never otherwise in the aquatic species, as might be inferred from the remarkable constancy with which some of these forms occur in definite positions on the elytra or elsewhere; but may doubtless be otherwise effected, at least in cases where more or less gregarious hosts inhabit or hide during the day in moderately moist situations. Under these conditions it is not improbable that spores discharged upon materials with which such insects have come in contact may subsequently adhere to other individuals on which they may develop. Although a gelatinous envelope is always a protection of extraordinary efficacy, it does not seem probable that the spores can retain their power of germination for any considerable time, at least in a dry condition.

Having reached a proper host, and having adhered to it by virtue of its generally viscous character, the spore begins to germinate at once.

Germination. The first indication of germination in the spore usually consists in the modification of its lower extremity into a blackened organ of attachment, the *foot;* the blackening resulting from a change which takes place in the gelatinous envelope in this region by which it becomes converted into a black, opaque, hardened, more or less elastic medium of attachment to the host. This conversion of the lower portion of the basal spore segment into an indurated organ by which the growing plant adheres firmly to the substratum on which it grows, is apparently unconnected with any effect resulting from contact with the chitin of the insect; since, in exceptional instances, where the usual discharge of spores has been prevented from any cause, the latter, while still within the perithecium, may begin to germinate and even attain an advanced development (Plate V, figs. 1 and 19). In such cases the first step in the process consists, as in normal germination, in the formation of a blackened foot of the usual type. A foot of this nature is not, however, invariably present. If the figures of Peyritsch are to be relied upon, there is no such blackening in the case of Helminthophana (Plate VIII, fig. 10), which is represented as penetrating the integument of the insect on which it grows by the intrusion of a papillate haustorium, there being no blackening whatever of the basal cell. The typical foot is also conspicuously absent in certain other genera. In Moschomyces also, to which reference has been made above, this organ is not differentiated; and the plant penetrates the soft integument by means of a cellular haustorium which, expanding within the body cavity of the host, holds the parasite firmly attached. The most striking exception, however, is presented by the genus Rhizomyces, in which the penetrating haustorium reaches a development quite beyond that of any other form. In this case (Plate

IV, figs. 1 and 3) the basal cell sends into the body cavity of the host a copiously branched and well-developed rhizoid-like organ, the interior of which is apparently continuous with that of the basal cell.

In cases where a typical foot is formed, it may constitute a cell distinct from the basal cell of the individual, as is at least often the case in *Stigmatomyces Baeri* (Plate I, fig. 14), a condition which may very likely exist in many other instances, although obscured by the blackening already mentioned. In some instances this blackening involves more than the basal cell of the mature plant, as in some species of Ceratomyces (Plate XXV, figs. 15 to 17).

In forms like those just mentioned in which a definite haustorium is present, it is quite evident that this organ constitutes the means by which the parasite absorbs from its host the nourishment necessary for its growth, and at the same time serves to fasten it securely. In the great majority of instances, however, it is probable that there is no intrusion of any kind from the ordinary form of blackened foot into the substance of the host. That this is the case may be clearly seen in preparations in which the parasite is shown attached to some transparent portion of the host's integument, as in fig. 4, Plate III. In the specimen here represented several individuals were fixed to the surface of the thin integument of one of the abdominal segments of the host, the substance of which was perfectly transparent, so that by inverting the piece to which they were attached, so as to view its lower surface, one could observe with accuracy the relation of the adherent portion of the foot to the chitinous surface to which it is applied. In such a specimen it is evident that this sucker-like adherent portion consists of a flat area in the closest contact with the chitin of the integument, and consisting of a thin membrane through which the absorption of nutriment takes place, bordered, as in the figure cited above, by the thick base of the indurated external wall of the foot proper. It should be mentioned, however, that Peyritsch figures sections of a fly's integument which indicate a slight penetration through the pore canals in the case of Stigmatomyces.

In addition to its function of attachment and absorption the foot may, in some of the aquatic genera more particularly, perform the office of a fulcrum on which the plant is supported and by means of which it is allowed a certain freedom of motion which it could not otherwise attain. This is effected through the more or less sudden and distinct enlargement of the foot above its point of attachment. The rounded fulcrum thus produced rests on the surface of the host, allowing the body of the plant, although appressed, to lie free from the insect and to roll upon it from one side to the other, as far as the elasticity of the attached portion will permit. This is most clearly

seen in Chitonomyces (Plate XXVI) or Hydrœomyces, both of which genera inhabit hosts that live, for the most part, submerged, and which are rapid swimmers. Under these conditions of life the advantages of such a contrivance, to allow a certain freedom of motion, are sufficiently apparent. The same office of a fulcrum for the support of the perithecium is effected in some species of Ceratomyces by the conversion of a considerable portion of the receptacle into a foot-like organ (Plate XXIV, fig. 1).

After having become attached to the insect, and during, or sometimes before, the formation of a definite foot, the spore elongates more or less distinctly and becomes further divided by the formation of tranverse septa into a series of superposed cells, varying in number in the different species and genera, from the further development of which result the three fundamental parts of which these plants are usually composed: namely, a main body, the *receptacle;* one or more spore-producing portions, the *perithecia;* and lastly, one or more *appendages* which, in the majority of cases, are associated with the formation of the male sexual organs.

The Receptacle. The term "receptacle" has been used to designate that portion of the fungus on which the appendages, together with the perithecia or their stalk-cells, are inserted; but it is necessarily used with some looseness, and is sometimes unavoidably applied to series of cells which are neither homologous in origin nor similarly related to the other essential organs of the plant. In the genus Laboulbenia, for example, the whole body of the individual, exclusive of the appendages and perithecium, is spoken of as the receptacle; although, in this instance, it consists fundamentally of the usual two superposed basal cells, while distally it is formed from a consolidation of the stalk-cell of the perithecium (cell VI), which has become laterally united with what is in reality the base of an appendage (cells III–V). In other cases it is often difficult to determine exactly how the receptacle should be limited, as, for example, in the genus Chætomyces (Plate XI, fig. 20), in which it consists of a single series of superposed cells which give rise directly to perithecia or to appendages.

The simplest type of receptacle, which is found in more than half of the genera, consists of only two superposed cells, the upper of which bears the appendage, at first terminally; while the perithecium, or perithecia, if there are several, are lateral productions from the same cell. This type is well illustrated by such genera as Haplomyces and its allies (Plate VII) Compsomyces (Plate XI, fig. 7) and similar instances; while, as has been above indicated, even genera like Laboulbenia are fundamentally similar. In other genera various degrees of complication are found in the development of the receptacle which passes gradually from the simple two-celled type to

such highly developed forms as are present in Zodiomyces (Plate XXIII) in which it attains its maximum development as compared with other known genera of the group. Other multicellular forms may be illustrated by such genera as Chætomyces or Enarthromyces (Plate XI, fig. 20 and IV, fig. 8), in which it consists of a single row of superposed cells, and Rhachomyces (Plate XII), in which, from a similar simple axis a series of appendiculate cells is cut off on one side, the predominance of transverse divisions resulting in an elongate form. As an illustration of the reverse condition where a predominance of longitudinal divisions is present, genera like Dichomyces or Diplomyces may be mentioned, in which the habit is stout and compact, this type reaching its greatest complication in the genus Zodiomyces just referred to.

Although the number and arrangement of the cells which form the receptacle in a given genus is often very constant, this is by no means invariably the case; and, even in the same species, fixity in this respect does not always exist. In Peyritschiella, for example (Plate VI), although the individuals of a given species do not vary greatly, in so far as the number and arrangement of the cells is concerned, no two species are alike in this respect. The same is true to a more marked degree in Rhachomyces (Plate XII), a genus which is further remarkable from the fact that the main body of the receptacle is in the nature of a lateral proliferation from the sub-basal cell of what may be termed the primary receptacle, as well as from the fact that this proliferation may be once or several times repeated, as will be presently noted. Again, in Ceratomyces there may be wide variations in this respect, not only between different species, but in individuals of the same species; while in other instances in this genus the number and arrangement of the cells of a given species may be invariable.

In the simple as well as in the more complicated forms, the receptacle is more or less flattened, usually in an antero-posterior plane, the side bearing the appendage in the mature individual being considered for convenience "posterior," where this distinction is possible. In some instances, however, the flattening is in a plane at right angles to that just mentioned, as in Dichomyces and Diplomyces. In a majority of instances this flattening is well marked; but it is most pronounced in forms which have a distinctly appressed habit of growth in relation to their substratum.

Appendages. With but a single exception in the whole group of Laboulbeniaceæ, the receptacle gives rise to one or more appendages which, though not invariably, are, as a rule, clearly distinguished from it, as well as from the perithecium. These appendages, though extremely variable, and affording, in many cases, excellent specific distinctions, are chiefly important from the fact that they are, with few exceptions, associated with the production of the antheridia or male sexual organs of the plant. In

all cases the primary appendage is originally a terminal structure, developed at least in part, often entirely, from the terminal spore segment, which is as a rule distinctly smaller than the basal, and never under any circumstances concerned in producing any portion of the true receptacle. While this terminal character of the primary appendage is often obscured, as in Zodiomyces, Rhachomyces and other genera, it is in many cases sufficiently evident; for example in such instances as Stigmatomyces (Plate I, figs. 2–13), Cantharomyces (Plate VII), and the like. In the genus Rhachomyces the primary appendage is represented by the single small bristle at the very base of the whole series of appendages, which are thus nearly all secondary and quite different in origin from the originally terminal primary one. Again, in Zodiomyces the originally terminal primary appendage is soon sloughed off, its place being taken by a multitude of secondary ones, also quite different in origin.

Although they are very important from a systematic point of view, it would be quite superfluous in the present connection to enter into any detailed description of the many variations of form and structure which the appendages, both primary and secondary, exhibit; and further details should be sought in the special descriptions of the genera. It is sufficient for the present purpose to say that the appendages, using the term to include both primary and secondary, may be solitary or very numerous: greatly elongated or consisting merely of single short cells; simple or branched in a great variety of ways, either sympodially or monopodially, or more or less irregularly; hyaline or deeply colored; stiff and bristle-like or flexuous and slender; in short, as may be seen by a glance at the accompanying plates, showing wide variations as to minor details even in nearly related forms.

The sterile appendages, or the sterile portions if such are present of fertile appendages, which are always more or less filamentous and composed of successive cells placed end to end, may become very highly developed, forming a dense tuft which is often much more conspicuous than the main body of the plant itself. The function of such highly developed sterile branches is doubtless primarily that of protection for the delicate trichogyne, which is subsequently developed, and they may, perhaps, have a further office in facilitating the fertilization of this organ by holding around it a drop of water, which is usually found at times condensed on the surface of the hosts, the majority of which are apt to hide by day, at least, in cool moist situations. It might be supposed that since these sterile portions of the appendages extend, in many cases, beyond or around the tip of the perithecium, that they were of some assistance in the dissemination of the spores; but it is a curious fact that the latter, despite their generally viscous nature, are only in exceptional cases found adherent to any portion

of them; and it seems certain that they do not thus act as brushes for the more convenient transfer of these bodies. In general the ultimate filamentous sterile branches, or branchlets, consist of a single series of superposed cells which appears to elongate, at least in so far as I have been able to determine, through the successive division of the terminal cell.

One curious structure, the significance of which is as yet undetermined, should be mentioned before leaving the sterile portions of the appendages. This structure consists of a spine-like process laterally developed from the primary appendage, and has been observed in only a few instances. It is most pronounced in an apparently undescribed genus parasitic on *Tachinus pallipes*, which has not yet been found in a mature condition. It also occurs in *Sphaleromyces Lathrobii* (Plate XI, fig. 19) and in *Rhadinomyces cristatus* (Plate IX, fig. 22), in both of which it seems to disappear at an early period. The process which is persistent at the summit of the antheridium in Haplomyces may also be of a similar nature.

Male Sexual Organs. As has been previously mentioned, the essential function of the appendage, apart from the secondary function of protection which it undoubtedly subserves in many cases, is as a rule connected with the production of the male sexual organs; although in the following genera, Amorphomyces, Dimorphomyces, Dimeromyces, Enarthromyces, Peyritschiella, and Dichomyces (probably also in Chitonomyces and Hydræomyces), the latter are wholly independent structures unconnected with the sterile appendages which usually accompany them.

A comparison of the character of these male organs in the different genera makes it apparent that they afford the best, indeed the only basis for the natural separation and grouping of the members of the family as a whole, which are thus distinguished into two main categories: one including those forms having male organs from which the male elements are produced exogenously; the other including those forms in which the male element arises endogenously. Of these groups the first may be further subdivided, on a similar basis, into forms in which the male organs are borne on specialized male individuals, and those in which the sexes occur together on the same individual. Again, as will be seen presently, these monœcious and diœcious groups are further distinguished according as the male organs are simple or compound; while their relative position, distribution, etc., afford opportunities for minor subdivisions.

Since they are undoubtedly homologous with similar structures in the Florideæ, the male organs and male elements in the Laboulbeniaceæ may be properly designated as *antheridia* and *antherozoids*, respectively; the former, as will be seen, consisting of a

single "antheridial cell," or a group of such cells, the latter of a single naked or thin-walled cell.

If we separate the genera of Laboulbeniaceæ, on the basis above outlined, into forms with endogenous and those with exogenous antherozoids, it will be found that it is only in two aquatic genera that the forms included in the first-mentioned category occur: Zodiomyces and Ceratomyces being the only instances in which this type has been definitely observed. In general the antheridial branches are not highly differentiated even in the more typical instances; while were the demonstration of the existence of male elements of this type dependent on the data afforded by the less well-marked examples, one might be inclined to doubt the presence of any sexuality in such cases, despite the presence of a well-developed trichogyne. In Zodiomyces, however, the antherozoids are produced in the form of buds which arise from the tips of short special branches (Plate XXIII, figs. 21–23) which assume a rod-like form and eventually fall from their attachment. These bodies have a definite wall and seem to be sought by the tip of the trichogyne in a fashion to which reference will be made below. A second well-marked instance is found in *Ceratomyces rostratus*, from the antheridial branches of which are developed rods of definite form and size, which become separated and adhere to the trichogyne. In this instance the rods are formed successively from a definite point at the distal end of the fertile cells of the antheridial branch (Plate XXIV, figs. 23–24), each rod usually becoming detached from its point of origin before its successor has begun to form. In other species of the genus, however, these bodies are not so clearly differentiated, and seem to be replaced by slender, often long, filaments which eventually break up into rods that are presumably functional as antherozoids. The adherence of the antherozoids to the mother-cell, or to one another, as in the last two instances mentioned, may be assumed to render fertilization more certain; since it is evident that were such bodies separated, as soon as they were mature, from a plant growing, as in the present instance, on an isolated and rapidly swimming host, the chances of their ever coming in contact with and adhering to the trichogyne would be reduced to a minimum. In view of the fact that this separation does not seem to take place at once, and that the long slender trichogyne must, from its position, inevitably be continually brought into contact with them while still *in situ*, through the motion of the plant which would necessarily result from the activities of its host, it seems quite probable that such antherozoids, in order to be functional, must become detached at the moment when they come in contact with and adhere to the trichogyne.

In all other genera of the family the antheridia are more complicated in

structure, consisting of highly specialized cells, or groups of cells, within which the antherozoids are formed endogenously and from which they are discharged through a special orifice in the form of free, naked, or nearly naked protoplasmic masses. Among such antheridia two distinct classes may be clearly distinguished, which I have termed *simple* and *compound*, respectively: although instances occur in which antheridia of the "simple" type are so closely associated that they may be regarded as transitional forms between the two types. In the first class, the simple form is characterized by the fact that the antheridial cell is quite independent of any similar cells, however closely they may be united to it, and discharges its antherozoids into the surrounding medium through its proper mouth. In the second instance, on the other hand, several such cells, closely associated to form a specialized organ, discharge their antherozoids into a common cavity from which the latter make their escape into the surrounding medium through a single aperture.

The *simple antheridium* (Plate II, fig. 15) is usually a more or less flask-shaped cell, which may be solitary or associated with similar cells grouped together with or without regularity. Although in Amorphomyces, a genus wholly destitute of appendages, it results from the direct modification of the terminal portion of the germinating spore (Plate V, figs. 20 and 23), it originates in other genera as a terminal or lateral outgrowth from the appendage or its branches. In a majority of genera, if it does not terminate the appendage or one of its branches or branchlets, the antheridium is itself a branchlet, as, for example, when it is sessile; but in a few instances this terminal character is lost and the organ is formed as a definitely intercalary cell, as in Rhadinomyces. In the compound type, these cells seem always to be intercalary in origin, although material has not been available for the study of their development.

The form of the simple antheridium is remarkably constant, the single cell of which it is composed being distinguished, more or less abruptly, into a basal, somewhat inflated portion or venter; and a terminal, more slender, usually sub-cylindrical portion, the neck, originally developed as a terminal outgrowth, which, at maturity, becomes perforate at its apex for the discharge of the male elements. The cavity of the venter is separated from that of the neck by a kind of diaphragm, abruptly distinguished on the venter side, and much less so on the neck side. This diaphragm, which seems to be formed by the deposition of a ring of cellulose in the position indicated, is perforate in the middle so as to allow the contents of the venter to pass out into the neck through an opening which is much smaller than the diameter of the cavity of the neck itself (Plate I, fig. 26). The cavity of the neck therefore, which may be conveniently called the canal, though of about the same diameter throughout the

greater portion of its length, is more or less abruptly narrowed just before passing into the venter. The contents of the venter during its active period, as it increases in volume, pushes through the narrow opening in the diaphragm into the cavity of the neck, and the portions thus extruded, when they have reached a certain definite size, become separated from the mass whence they were derived; and, assuming the form of short cylindrical rods, the antherozoids pass into the general cavity of the neck, the diameter of which is but slightly larger than their own, and thence make their final exit through the terminal pore. This process of abjunction, by which small but uniform pieces become separated from the contents of the venter as it is pushed into the neck, continues for a period which varies somewhat in different cases, but may begin some time before the female organs are mature, and continue long after they have been fertilized. Although one sees many cases in which the neck contains a continuous series of antherozoids which are evidently pushing one another out through the terminal opening, these bodies seem to be able to make their exit quite independently of one another, although at the same time they also appear to lack any indication of a power of independent motion, amœboid or other.

As has been already mentioned, the form of the simple antheridium is subject to inconsiderable variations which depend in general on the relative development of the neck or of the venter, the latter being sometimes short and stout and abruptly distinguished, while in other cases it may run gradually into the neck without any such clearly marked differentiation. The neck, too, may be short and rather stout, or long and slender, straight or curved, the extremes in these respects being illustrated by such instances as the following: *Laboulbenia decipiens* (Plate XX, fig. 20), *L. Elongata* (Plate II, fig. 15), Teratomyces (Plate X, figs. 6 and 11), Compsomyces (Plate XI, fig. 14), or *Stigmatomyces Baeri* (Plate I, fig. 26).

The disposition of the antheridia, and their relation to one another on the same appendage or branch, is a matter of much importance in affording generic distinctions, and even, in a few cases, is of service in defining species. On this basis all the genera having simple antheridia, with the exception of Amorphomyces, which has invariably a single antheridium, might be separated into two categories: those in which the antheridial cells are disposed in definite series on the appendage, and those in which they are more or less indefinitely placed.

In the first category are found forms in which the series is a single one, as in Stigmatomyces (Plates I, figs. 8–12; VIII, fig. 3), the antheridial cells succeeding one another in a single vertical row, while a somewhat more complicated condition exists in Idiomyces, where three vertical rows are present (Plate IX, figs. 18–19). Again,

in Helminthophana there are four rows symmetrically arranged (Plate VIII, fig. 10) on the single appendage. In all these cases the antheridial cells are themselves branchlets from the axis of the appendage. In Rhadinomyces and Corethromyces, however, the entire axis of the antheridial branch is formed from the superposed venters of the antheridial cells, the necks alone being free and projecting in a vertical row (Plate IX, figs. 5, 9, and 14).

In Teratomyces a somewhat similar condition is brought about through the repeated sympodial branching of the appendage, the false branchlets (Plate X, figs. 6 and 11) being either antheridia or short sterile outgrowths, terminated by a characteristic beak-like cell. Although, in this last instance, a regular series of antheridial cells, either alone or mingled with sterile branchlets, is produced, the type is not strictly comparable with that of the previously mentioned instances; in which the antheridial cells or branchlets originate as a result of the septation of an axis already formed and the production of monopodial branchlets from the resultant cells. In Teratomyces it is evident that the serial arrangement is necessitated by the relative position of the crowded appendages.

In the second category may be included all the remaining genera, comprising forms in all of which the simple antheridia are not thus disposed in regular series, but are more or less irregularly placed on the appendages. Although never serially arranged through monopodial branching, individual examples occur, however, in which the grouping of the antheridia is very characteristic and specifically distinctive. Among the instances included in this general category, Laboulbenia is by far the best illustration, since it comprises a greater variety of forms than any other genus. Among those in which there is no definite relation in position between the antheridia, *Laboulbenia elongata* or *L. Pterostichi* may be mentioned, while among forms in which there is a more definite grouping, *Laboulbenia variabilis* (Plate XXI, fig. 3) or *L. proliferans* (Plate XVII, fig. 23) offer the best examples of more or less regular and distinctly characteristic clusters. Species in which the antheridia are borne in pairs, or are irregularly grouped, are common; while in one instance, the curious *L. zanzibarina* (Plate XVII, fig. 3), a single short series may result, as in Teratomyces, from continued sympodial branching.

In regard to the number of simple antheridia that may occur in individual cases, it may be mentioned that there are often wide differences, not only between different species, but between individuals of the same species. *Laboulbenia texana*, for instance (Plate XX, figs. 16–18), has one, rarely two, antheridia, while *L. elongata* may have from five to fifty or more. Wherever fertilization has failed, as not infrequently hap-

pens, the production of antheridia is greatly increased (Plate II, fig. 8). Further reference to this circumstance will be made in connection with the "abnormal forms" described below.

Turning to the *compound type of antheridium* we find much less uniformity than in the simple type just described, although the antheridial cells which make up the essential portion of this organ are practically identical with the simple antheridium. As has been already mentioned, these cells seem to be intercalary in origin as far as can be determined in the absence of a knowledge of their early development, and instead of being wholly or partly free, both the necks and venters are closely united below, beside or around a common cavity into which they discharge. Of the twenty-seven genera thus far described, about one-third are characterized by possessing this compound type of antheridium, and since that occurring in Dimeromyces is one of the largest and most easily studied, it may be taken as an illustration. In this genus the species are diœcious, and the male individual reaches a maximum differentiation, being as well developed as the female, and bearing more than one antheridium (Plate IV, fig. 16), which possesses a stalk-cell and four basal cells lying below the antheridial cells. The antheridial cells in this case are six in number, symmetrically arranged in two rows, their venters large and emptying through long narrow canals into the somewhat inflated base of the long and slender "secondary" neck which serves as a common medium for the final discharge of the products of all the antheridial cells. The latter here correspond closely to those previously described in connection with the simple antheridia, and the formation from them of antherozoids is also similar in all respects. The canal, however, does not enlarge, as in the simple form, immediately after leaving the venter; but continues about the same diameter till it has nearly reached the general cavity at the base of the secondary neck, when it expands slightly. As a result, the antherozoids remain in connection with the protoplasm of the venter till they project some little distance into the cavity of the secondary neck, eventually separating from it and falling free into this general receptacle, whence, as represented in the figure, they may be seen at various points making their way out. The antheridium of Dimorphomyces is essentially identical with that just described, the male individual in this genus, however, producing but a single antheridium (Plate V, figs. 8–9 and 14–15). In Peyritschiella (Plate II, fig. 12), Dichomyces and Enarthromyces (Plate III, fig. 19), although the antheridium is somewhat different in form, the secondary neck being less prominent and less abruptly distinguished, its general structure is also essentially the same; the four to six antheridial cells in the last mentioned genus lying somewhat obliquely side by

side in two rows, below a common cavity into which they empty. In these instances the antheridium has no stalk-cell, and is closely united to the receptacle. In Camptomyces and Eucantharomyces it terminates the appendage and is somewhat different in character. In Camptomyces the antheridial cells are placed around and beside a general cavity, and are arranged in several nearly vertical rows, emptying upwards through short necks into this cavity, whence they escape through the terminal pore of a short secondary neck (Plate VI, figs. 5 and 6). In Eucantharomyces the antheridial cells are also arranged in nearly vertical rows, and are more numerous than in the last mentioned genus. They empty into a general cavity, which is central and terminal, and are discharged through a well-developed, though somewhat irregular, secondary neck (Plate VII, fig. 27). In both these genera the material has been so limited in amount, and the antheridia are so difficult to observe by focussing through the asymmetrical arrangement of their numerous antheridial cells, that I have been unable to obtain a figure that would show satisfactorily the exact details of structure and arrangement presented by the latter. The gross structure is, however, made out without difficulty, and the general cavity is usually filled with very numerous antherozoids, which here and there may be seen in process of formation from the antheridial cells in a fashion exactly resembling that which occurs in the instances previously described.

A single type of compound antheridium remains to be mentioned, which occurs in Haplomyces and in Cantharomyces, and in this instance also, owing to the lack of sufficient material and to the complicated structure of the organ, much remains to be learned concerning its exact structure. The type is distinguished from those already mentioned from the fact that the secondary neck opens, as far as can be ascertained from the material available, through a lateral pore, and consists of a central cavity almost completely surrounded by the very numerous antheridial cells which open into it. This general structure may be made out by focussing through the organ; but no further details have been visible in the specimens examined. The antheridium (Plate VII, figs. 3, 9, and 22) is identical in the two genera mentioned, except that in Haplomyces it is terminated by a thorn-like cell, while in Cantharomyces it is placed below a well-developed sterile branching portion. With the exception of *Cantharomyces pusillus*, which may possibly prove to represent a new generic type, none of the species of these genera have been seen in a fresh condition, and they are the only ones possessing compound antheridia in which the discharge of the antherozoids has not been observed. The antheridium in these forms is the most highly developed that has thus far been noticed, and further observations upon it are greatly to be desired.

The antheridia are usually so placed that the antherozoids are discharged very near to, or even directly upon, the female organ when the latter is mature (Plate I, fig. 15; Plate II, fig. 2; Plate III, fig. 18). When they are associated with long and well-developed appendages, they are usually borne near the base of the latter (Plate II, fig. 5, anth.), and where also, as in the case of Laboulbenia, there are inner and outer appendages or branches, the male organs usually occur on the inner ones, that is, on those nearest to the female. There are, however, some exceptions to this rule in which the antheridia and trichogynes are not thus closely associated; as, for example, in Teratomyces, in which the former are borne some distance below the latter, and are curved away from them. In many cases also, though the two sexes may be closely associated, there is often a marked tendency in the male to turn away from rather than towards the female, as in Stigmatomyces and Eucantharomyces. In the diœcious genera, the male and female individuals are always in close proximity, their invariable association resulting from the fact that the spores always become attached to the host in pairs, corresponding to those which are formed in the ascus, and that, of any given spore pair, one member produces a male while the other produces a female (Plate V, figs. 2, 5, 17, 20, and 23). Notwithstanding the fact that the male and female organs are in general so closely associated, it is more than probable that cross-fertilization occurs quite as frequently, if not more frequently, than close fertilization; since not only are the species as a rule more or less gregarious in habit, but the maturition of the antherozoids invariably precedes that of the trichogyne, and the former continue to be produced long after the latter has been fertilized, in many cases after the perithecium has matured and begun to discharge its spores. This is true of forms having but a single perithecium; but more strikingly so in those which produce several successive perithecia. In Dimorphomyces, for example, the antheridium of the male individual continues to produce antherozoids indefinitely, while the female may produce two or even four sets of perithecia. The same extension of the functional period of the male is also seen in all the genera having compound antheridia. In forms having simple antheridia the same extension of functional activity in the male is often effected by the production of new antheridial cells or new fertile branches after the fertilization of the trichogyne.

As has been previously mentioned, the antherozoids are formed, in those genera which produce them exogenously, as lateral branchlets, the whole or portions of which become separated in the form of long slender rods (Plate XXIV, figs. 21, 24; Plate XXIII, figs. 21–23), having a definite cell wall, while in the genera producing them endogenously the contents of the venter of the antheridial cell are protruded through

the opening in the diaphragm into the cavity of the neck, and this protruded portion, having reached a definite size, becomes separated as a free mass of protoplasm, which, having been, as a rule, moulded to a cylindrical form in the cavity of the neck, makes its exit through the terminal pore. When free, the endogenous antherozoids exactly resemble bacilli or cocci in appearance, becoming rounded at the ends so that the short forms are almost spherical (Plate I. fig. 26; Plate VI. fig. 5; Plate II. fig. 2; Plate III. fig. 19). Their substance is refractive and homogeneous, and I have been unable, by staining, to differentiate a definite nucleus. Although, when first separated from the contents of the venter, they are undoubtedly naked protoplasmic masses, in some cases at least a thin wall seems to be secreted around them after their exit from the antheridial cell. In Enarthromyces, for example, which possesses antherozoids larger than those of any other known form, such a wall appears to be present, and the same may very probably be the case in other forms in which the antherozoids are so minute that exact observations in this respect are made with difficulty, even after they have become attached to the trichogyne. When freshly discharged they are usually sufficiently characteristic in appearance to be readily distinguished from the bacteria and yeasts which are often so numerous on certain individuals as to completely corticate the appendages.

The discharge of the antherozoids from the antheridial cell is a slow process, and probably does not occur more frequently than once every two or three hours; at least this is about the rate observed in individuals which have been separated from the host and placed in water. It may be, however, that the rate is more rapid under natural conditions; since the parasite does not survive very long after separation from the host, which doubtless disturbs not only its nutrition, but also its general turgescence. From the secondary neck of compound antheridia the discharge is, of course, often much more rapid at times, and a dozen or more antherozoids may be seen to make their exit within a few minutes after an individual of Camptomyces, for example, has been mounted in water. Cultures of the antherozoids in water, continued for many days, have never shown any indication of an attempt at development. Reference has already been made to the duration of the active period of the antheridia, and it remains to note the fact that the numbers of antherozoids formed during this period from a single antheridium must be counted by hundreds, or even thousands, in the case of the more highly-developed compound forms.

Female Sexual Organs. — It has been previously mentioned that in a majority of forms the antheridial appendage is developed from the terminal cell of the germinating spore. The female organs, however, are always formed from the products of

division of the basal cell, never in any case from the terminal cell, where this is present. Although the products of the division of the terminal cell are invariably sterile or male, it is not true, as might be supposed, that the basal cell or its derivatives have any inherent female character; since, in many cases, both normal and abnormal antheridia and antheridial branches may arise below the point of insertion of the female organ, or even, in exceptional cases, replace it entirely (Plate II, figs. 7–8). While, then, the primary appendage is, as a rule, terminal, the trichogyne, as well as the perithecium which follows it, are always lateral, with the single exception of Amorphomyces, where both are developed terminally from the unsegmented spore. This lateral origin is, however, very often obscured in the fully developed plant, from the fact that the perithecium, as it develops, is apt to push the appendage more or less to one side, and assume an apparently terminal position; as, for example, in the genus Stigmatomyces or in Laboulbenia.

We have already seen that the basal cell of the germinating spore begins its development by the formation of a cross partition which divides it into an upper and a lower cell, and that the base of the latter becomes modified to form the foot. The development of the upper, although varying considerably in the different genera, may, perhaps, be best illustrated by reference to the series of figures (Plate I, figs. 1–24) of Stigmatomyces, which is typical of the more simple forms. In this series, fig. 2 represents the spore after it has become attached to the host, the foot is beginning to form and the upper half is considerably enlarged. Figs. 3–5 illustrate the further development of the upper cell, the lower still remaining as at first. In fig. 6, the lower cell has become divided into two superposed cells, the upper of which (*b*) forms the basal cell of the appendage. The lower cell (*y*) then divides in two by a transverse partition, forming the basal cell and the sub-basal cell (*a*). This sequence of divisions is not apparently constant, and in other forms, at least, it more frequently happens that the partition which separates (*a*) from the basal cell is formed before that which separates (*a*) from (*b*). In fig. 7, the nucleus of cell (*a*) has already divided, although no wall has formed between the daughter nuclei. In fig. 8, this wall has been formed and the cell (*a*) has become divided into an upper and a lower cell (a' and a''), cell (*b*) remaining permanently without further division as the base of the appendage. Of these two cells (a' and a''), the lower remains without further change as the terminal cell of the receptacle; while the upper (a') alone continues to develop into the female sexual organ and the perithecium. It will be noticed that even at as early a stage as is represented in fig. 8, the antheridial cells have begun to mature and to discharge their antherozoids. Cell (a') next begins to grow upward and

outward (fig. 9), and by the formation of a septum is soon divided (fig. 10) into an upper and a lower cell (*d* and *c*). From the upper of these cells, which may be called the *primordial cell of the procarpe*, is formed the whole of the female sexual organ, while from the lower (*c*), which may be similarly called the *primordial cell of the perithecium*, are developed the cells which form the perithecium proper. This lower cell (*c*) is the first to show further signs of development, and becomes divided by a more or less obliquely longitudinal septum (fig. 11) into two cells (*c″* and *c′*). The cell (*c″*) then begins to grow upward, and becomes divided into an upper and a lower portion, fig. 12 (*z*) and (*p*). The lower cell (fig. 12, *p*) constitutes the "stalk-cell," while the upper continues to divide, as will be presently described. The cell (*c′*) of fig. 11, on the other hand, becomes separated into two upper cells (fig. 12, *i, i*), lying on opposite sides so that only one is shown in the figure, and a lower cell (*h*), which may be called the secondary stalk-cell. The cell (*z*) and the cells (*i, i*) then continue to grow up around the base of the cell (*d*), the primordial cell of the procarpe. One of the cells (*i, i*) then becomes separated into a single lower and two upper cells, while the other becomes separated into a single lower (figs. 13, *o*) and a single upper cell (*n*), as also does the cell (*z*); the cells (*o′*) and (*n*) of fig. 13, resulting from its divisions. There are thus formed three proper basal cells of the perithecium, two anterior (*o, o*) and one posterior (*o′*), but two of which are shown in the optical section (fig. 13), and from them four cells are separated above which continue to grow upward and surround the cell (*d*), the base of which is now (fig. 13) completely enclosed and has become separated by a cross partition as the cell (*f*) from the part (*e*) which still remains free above it.

We then have this basal part (fig. 13) constituting a central cell (*f*), distinguished from the free part above (*e*) by a cross partition, and completely surrounded by the seven cells (*o*, *o′* and *n*, *n*), but four of which are, of course, shown in the optical section. The central cell (*f*) then remains without further development until fertilization has taken place; the terminal portion of cell (*e*) in the mean time becomes separated from the part below (fig. 14, *e″*) as a usually very small cell (*e′*), which immediately begins to produce a terminal outgrowth, the young trichogyne. This small cell is more marked in the genus illustrated than in most others in which it is not, as a rule, so clearly distinguished; the filamentous portion usually growing directly from the apex of cell (*e*), from which it is separated by a septum (Plate II, fig. 2). Cell (*e′*) and the projection (*tr*) from it must therefore be considered as constituting together the trichogyne proper. As the latter develops, the cell (*e′*) becomes less well marked, while the filamentous portion reaches a development that varies in

different specimens, but is usually not greater than is represented in fig. 15 (*t r*) and in fig. 16. Before fertilization it can be clearly seen, as in the last-mentioned figure, that the trichogyne and the basal cell (*c'*) constitute a single cell, and the nucleus is usually readily made out in the position indicated at the base of the trichogyne. Meantime the cells (*n n*) and (*o o'*) of fig. 13 have increased in size, and the former have begun to grow up still further around the base of cell (*e*), fig. 13, (*e''*), fig. 14.

With the maturity of the trichogyne the female organ has completed its development, and we have the condition represented in fig. 15, from which it will be seen that the latter, which may be conveniently termed the *procarpe*, consists of three distinct parts, which, so far as is known, are present in all genera of Laboulbeniaceæ. Of these the uppermost may be properly called the *trichogyne*, and in the present illustration is unicellular, though often, as will be seen presently, far more complicated in structure; the middle portion in this, as in all other instances, also unicellular, which we may call the *trichophoric cell* (*e''*), and the lowest portion (*f*), which may be termed the *carpogenic cell*, being that portion of the procarpe which is fertilized, and the only part which persists and undergoes further development. As is shown in the figure, the carpogenic cell is completely surrounded by eight cells, four of which (*o o*) lie below and around it, and, remaining undivided, form the basal cells of the mature perithecium; while the four others (*n n*) completely surrounded it, and, as will be seen later, form by further division the wall- and lip-cells of the perithecium. These eight cells are arranged in four longitudinal rows, and, in the stage represented, the upper four have already begun to grow up around the trichophoric cell, the lower half of which is now enclosed by their advancing tips. In the stage represented in fig. 15, the antherozoids, which have been continuously escaping from the antheridia since the stage represented in fig. 7 was reached, begin to adhere to the trichogyne, often in larger numbers than are represented in the figure, and fertilization is accomplished, probably with considerable rapidity if one may judge from the rarity of conditions which are intermediate between that represented in fig. 15 and that shown in fig. 19, where the trichogyne has entirely disappeared. In the comparatively infrequent instances in which one finds an adherent trichogyne belonging to a procarpe in which fertilization has evidently been accomplished, slight elevations may be seen which coincide with the position of usually more than one of the antherozoids (figs. 17 and 18). In such cases, although it is very difficult to determine the actual presence of conjugation in the case used for illustration, it is evident that a wall has been formed around the antherozoid, which often seems inflated and nearly empty of contents.

In brief, then, we find the female organ developed at first as a lateral outgrowth from one of the cells of the receptacle. From this outgrowth a terminal and a subterminal cell are cut off. From the former of these by further division is produced the procarpe, consisting of a terminal receptive portion, the trichogyne, a middle connecting portion, the trichophoric cell, and a lower essential portion, the carpogenic cell, which alone develops further; while from the latter arises by further division the whole of the perithecium proper. The subterminal cell thus forms the basal and wall-cells of the perithecium, while the terminal one, although at first quite free, forms its contents.

The further development of the young perithecium after the fertilization of the trichogyne may be also best illustrated by reference to the same series of figures of Stigmatomyces (Plate I, figs. 17–24). In fig. 17, which represents a condition in which fertilization has been completed, the procarpe remains unchanged, except that the carpogenic cell (*f*) has become somewhat enlarged and elongated. In fig. 18, the first indications of development are seen in the carpogenic cell, which, through the formation of two transverse partitions, has become divided into three superposed cells, while the trichogyne has begun to wither. As a rule, however, it has entirely disappeared when the first divisions of the carpogenic cell are visible. In fig. 19, this division of the carpogenic cell has become still more pronounced, and nothing remains of the trichogyne but its insertion. Disregarding the accompanying development of the wall-cells of the perithecium, and following only the divisions of the carpogenic cell, we may distinguish the three cells into which it first divides as follows: the lower of the three (*i s*) may be termed the *inferior supporting cell*, while the upper constitutes the *superior supporting cell* (*s s*). The remaining cell, which lies between the two, may be conveniently termed the *ascogonium* (*a m*), and is the only one of the three which undergoes any further development; the two supporting cells eventually disappearing entirely. Up to this point the development of the procarpe is similar in all the genera, so far as they are known; but the further divisions of the ascogonium show certain variations in different genera and even, apparently, in different specimens of the same species, although it is improbable that individual variations of this nature are at all common. In the present instance the ascogonium divides into a lower and an upper portion, the latter at the same time dividing, by somewhat irregularly longitudinal septa, into four cells. The lower portion (figs. 20–23, *i s t*) remains unchanged, being eventually destroyed, like the two supporting cells (*s s* and *i s*), and may be called the *secondary supporting cell*. We have then the ascogonium dividing simultaneously into five cells, one of them, the secondary supporting cell, remaining

sterile, while the others constitute the *ascogenic cells*, and at once begin to bud upward; the buds (fig. 21, *a s*) developing into asci (fig. 22, *a s*), and in this, as in a majority of cases, arising in a more or less distinctly double row. (See Plate I, fig. 38; Plate III, fig. 1; Plate V, fig. 18.)

In Stigmatomyces the four ascogenic cells, but two of which appear in the figures, are at first symmetrical neither in form, size, nor arrangement; but, as the asci begin to develop, become so placed that one is anterior, one posterior, and one lateral on either side. In fig. 23, which represents an antero-posterior view, the two lateral ascogenic cells are shown, placed more or less symmetrically with reference to one another, the anterior and posterior ascogenic cells (not shown in the optical section) occupying a similar relative position in front of and behind them.

Returning now to the perithecium proper, which we left in the condition represented in fig. 15, it will be remembered that it originated as a single cell (fig. 10, *c*), which has divided several times, and that the upper products of these divisions have grown up around the base of cell (*d*), from which, as we have seen, the female organ is developed. In this stage (fig. 15), it will be seen to consist of the stalk-cell (*p*), the secondary stalk-cell (*h*), and three basal cells (*o*), but two of which are visible in the figure, and four primary wall-cells (*n*, *n*), which surround the carpogonium (*f*) and the base of the trichophoric cell (*e''*). At a stage slightly earlier than that represented in fig. 15 a further development from the three basal cells takes place, which is not indicated in the optical section. This development consists in the upgrowth from the basal cells (*o*) of four cells corresponding to the wall-cells, but alternating with them and lying partly between them and the carpogonium. As they continue to grow upward and to increase in size, they separate the wall-cells completely from the structures developed from the carpogenic cell, growing up around the latter in a fashion exactly resembling that of the wall-cells. There are thus developed from the three basal cells, eight cells arranged in two series; an outer, the primary wall-cells, four in number; and an inner, also consisting of four cells. The further growth and the successive divisions of the cells of these two series, although its course is identical, is, nevertheless, quite independent in either case; the divisions of the cells of the inner series occurring in general after those of the outer series have taken place. The further development consists simply in a continued upward growth around the products of the division of the female organ, accompanied by the separation of a terminal portion. The latter is then again separated into two portions, the upper of which divides again, and so on, until the number of cells characteristic of the genus or species has been formed. This process may be made somewhat clearer by reference to figs.

17–20. In fig. 17, the primary wall-cells (fig. 15, *n, n*) have undergone their first division, having each separated into an upper and a lower cell (*w* and *n'*). The four cells of the inner series (*n''*) have also been developed from the three basal cells (*o, o*); but, although they extend upward above the septum which has divided the wall-cells, they are not themselves as yet septate. In fig. 18, the wall-cells remain as before, but each of the cells of the inner series has divided into two, (*p c*) the parietal cells and (*n c*) the primary canal-cells. In fig. 20 the primary canal-cells have again divided into two (*n c'* and *n c''*), and this division has been preceded by a corresponding separation of the upper wall-cells (*w, w*) into the two cells (*w x* and *w x'*). This condition continues until the asci have reached a considerable development (fig. 23); but before any of them are mature a last division takes place, by which the cell (*n c''*) of the same figure is separated into the cells (*c c*) and (*t c*) of fig. 24, and the cells (*w x'*) are separated into (*w y*) and (*w z*). In Stigmatomyces, then, there are present in the mature perithecium, before the spore discharge has commenced, an outer series of *wall-cells* disposed in four longitudinal rows of four cells each, the terminal cells of which may be conveniently called the *lip-cells*, and also an inner series of cells alternating with the outer, and also arranged in four longitudinal rows, each made up of four cells, the lower of which may be conveniently termed the *parietal cells*, the three others being distinguished as the *canal-cells*. There are thus four parietal cells, twelve canal-cells and sixteen wall-cells, making a total of thirty-two cells in the perithecium proper, exclusive of the three basal cells, the stalk-cell and the secondary stalk-cell previously alluded to (*o, h*, and *p* of fig. 15).

The asci, in the mean time, have continued to bud from the ascogenic cells, so that their total bulk has greatly increased, and as a result the ascus mass begins to exert a considerable pressure in all directions on the surrounding cells. In this way the superior supporting cell, the secondary inferior supporting cell, and the parietal cells are gradually destroyed, and in most instances, though not usually in that which has been used as an illustration, the inferior supporting cell is eventually obliterated by pressure. In Stigmatomyces the lower series of neck-cells (fig. 24, *n c'*) become gradually inflated towards their distal ends and their walls are somewhat thickened, so that they act as guard-cells which control, to some extent, the passage of the spores from the general cavity of the perithecium to that of the neck. The asci as they mature are sloughed off from the ascogenic cells, and rapidly disappear, their walls being absorbed as soon as the spores are completely formed, so that the latter lie free in the cavity of the perithecium. The spore mass thus formed, being constantly augmented, pushes between the guard-cells (*n c'*) just mentioned, and being forced still

further upward, destroys the two remaining series of canal-cells (*c c* and *t c*), and finally forcing their way between the lip-cells (*w z*) the spores make their exit through the permanent pore thus formed.

The special instance which has been selected as an illustration of the development of the female organ, although it may be considered typical of the process as it occurs in the family generally, does not, as has been noted, represent the invariable course of development in all cases, when the details of the successive changes are considered; and it will therefore be necessary to compare the processes described with the corresponding conditions presented by certain other genera.

The exact point of origin of the bud which is to develop into the perithecium, in so far as concerns its position with reference to the cells of the receptacle, is, as has been previously mentioned, subject to many variations in the different genera, although that which has just been described is the most common. The genus Amorphomyces, to which reference has several times been made, presents the most essential difference in this respect; since the terminal and subterminal cells of the germinating spore constitute the primordial cells of the procarpe and of the perithecium proper, respectively; the latter dividing and growing up around the former as in the case of Stigmatomyces just described (Plate V, fig. 23, *d*, *c*). In several other cases, as in Rhadinomyces and Enarthromyces (Plate III, figs. 13–18), the female organ first appears as a free bud, developed from a cell, not necessarily the sub-basal cell, of the receptacle; and this bud having become divided by a cross partition into two superposed cells, the same changes which have already been described in detail, take place in essentially the same way, as will be presently noted.

A very remarkable variation from the method above described by which the primordia of the perithecia and sexual organs arise from the receptacle, occurs in Zodiomyces; a genus in which these organs, instead of originating as superficial outgrowths, are formed as buds from a layer of cells which line the bottom of the cup-like extremity of the receptacle. This cup-shaped portion, though open at maturity, Plate XXIII, fig. 8, originates as a closed cavity below the base of the primary appendage, fig. 5, *x*, which becomes open as a result of the destruction of the superficial cells above it, which is effected by numerous sterile appendages that make their way out, fig. 6, *y*. The cells which give rise to the perithecia are thus primarily derived from the central parenchyma of the body of the receptacle. The course of development of the perithecia, in this instance, does not appear, however, to differ very materially from that already described.

Apart from these differences in origin, the development of the female organ corre-

sponds very closely in all the genera, up to the formation of the procarpe, with certain differences of detail; and in all cases the mature procarpe consists, as in Stigmatomyces, of the three essential parts above mentioned. The carpogenic and trichophoric cells are practically identical in all cases; but the trichogyne is subject to very considerable variations, even in the same genus. In its most simple form it is unicellular, as in the case of Stigmatomyces, without branches, and of no great length. Other unicellular trichogynes may be more or less branched, consisting of an abruptly enlarged portion from which radiate more or less irregular short lobes or branches, which are the receptive portions, sometimes quite numerous, as in the genera Amorphomyces and Dimorphomyces (Plate V, figs. 4, 5, 20, and 24), Camptomyces (Plate VI, fig. 4); and, to a less extent, in Peyritschiella and Dichomyces, both of which have trichogynes which are nearly simple or but slightly lobed (Plate VI, figs. 16 and 32). A similar trichogyne appears to be characteristic of Dimeromyces (Plate IV, fig. 17); but sufficient material is needed to determine this point.

The multicellular trichogynes, which are the more numerous, may be branched or simple, even in the same species, and sometimes reach a very remarkable degree of development; becoming many times septate and copiously branched, the free extremities being either straight or more or less definitely spirally twisted (Plate II, figs. 1–5, *t r*, and Plate XXI, fig. 15). The terminal portion of the trichogyne alone is receptive, and it is this part which is subject to the spiral twisting, the most striking instance of which occurs in the genus Compsomyces (Plate XI, figs. 9 and 10), well developed specimens of which, like that represented in fig. 9, producing more highly developed trichogynes than are found elsewhere in the family. In all cases the receptive tips have the same refractive appearance when mature that is noticeable in the corresponding organs of the Florideæ, and the continuity of the protoplasm of successive cells is readily demonstrated, as in other parts of the plant. However highly the trichogyne may be developed, it disappears with great rapidity as soon as fertilization has been accomplished, collapsing and breaking off, its point of insertion sometimes remaining as a scar-like prominence (Plate II, fig. 14, *t r*); while less frequently its base becomes somewhat indurated and persists even in the mature individual (Plate XXI, fig. 12 and Plate XVII, fig. 18). In a majority of cases, however, all signs of it have disappeared at an early stage in the development of perithecium after fertilization.

The process of fertilization, in so far as concerns the adherence of the antherozoids to the trichogyne, has been already referred to; the former in almost all cases being carried to the latter, whether they are discharged directly upon it or make their way to it by floating passively through the water, which, as we have seen, is apt in a

majority of instances to surround the individuals while their hosts are hiding in moist situations. The genera in which the antherozoids are exogenous in origin probably form an exception to this rule, and the transfer may be effected as above described (p. 210). At all events, the trichogyne in the genus Zodiomyces always grows downwards (Plate XXIII, fig. 16) as it develops and seems to seek the antherozoid which is almost invariably found attached to its tip (figs. 17, 18), and it is only after contact with the antherozoid that it turns upward as is shown in the two last-mentioned figures. In this instance several specimens have been examined in which there seemed to have been a definite conjugation between the two organs, as in fig. 17; but as a rule this union cannot be satisfactorily demonstrated owing to the very small size of the male element.

The fertilized trichogyne usually disappears before any definite change takes place in the other cells of the procarpe; but soon after this disappearance the divisions of the carpogenic cell already described succeed one another with considerable rapidity, and correspond at first in all the genera so far as they are known. The carpogenic cell divides by two transverse septa into three superposed cells, the superior and inferior supporting cells and the ascogonium; and the latter, at least in many of the instances observed, becomes separated into a lower sterile part which has been above described as the secondary inferior supporting cell; while the upper part either remains without further division, constituting the single ascogenic cell, as in Amorphomyces, Sphaleromyces, Peyritschiella (Plate I, figs. 28, 29) and a few other genera; or becomes divided into two such cells, as in Laboulbenia (Plate I, fig. 35, *a c*) and in many other genera in which this is the usual number. Less frequently the number of ascogenic cells may be four, as in the case of Stigmatomyces above described; while in only one genus, Haplomyces, have *eight* such cells been definitely observed. Although the number of ascogenic cells is moderately constant in a given genus, it does not appear to be invariable, and I have seen rare instances in which two were present in forms having typically only one; while in a single instance a specimen of Rhadinomyces was observed in which three were distinct within the perithecium in place of the usual four; a condition doubtless due to the abortion of one of the original products of the division of the ascogonium.

The form of the ascogenic cell, though generally similar in most of the genera, is subject to certain variations, and the position which it occupies in the cavity of the perithecium is sometimes characteristic in given instances. In Rhizomyces, for example, it lies somewhat obliquely in relation to the axis of the perithecium, so that the ascus mass has the appearance represented in Plate III, fig. 3; while in *Chitonomyces*

paradoxus it is nearly horizontal, so that the asci growing inward, downward, and upward are much bent and distorted when mature. When they occur in pairs the ascogenic cells are more or less symmetrically arranged, and when there are but two, lie facing one another in a plane at right angles to that in which the perithecium is flattened. Where there are two or four pairs the perithecium is but slightly if at all flattened, and the ascogenic cells lie facing one another: one anterior, one posterior, and two lateral, or approximately so. The form of the ascogenic cell is subject to little variation, being, as a rule, oval in outline in face view; but in a few genera it is much elongated, as in Amorphomyces (Plate IV, figs. 25–28), or Sphaleromyces, and in the former case may possibly become divided by a transverse septum in certain instances.

In Stigmatomyces, as has been mentioned, the asci bud from the ascogenic cell, alternating first from one side, then from the other; so that, as a result, two definite rows are formed, such as are illustrated in Plate IV, fig. 18, in Plate I, fig. 38 (at the left), and in Plate III, fig. 1, all of which represent dorsal views of the ascus mass, the ascogenic cell lying away from the observer and being consequently invisible. In the last mentioned figure, a slight irregularity is noticeable from the fact that an extra ascus has been abnormally produced at one point lying in the median line between the two rows normally formed. The most conspicuous exception to this biseriate arrangement of the asci is found in the genus Moschomyces, the very large ascogenic cell of which gives rise to an enormous number of asci arranged in many vertical rows; and, although such variations are exceptional, there seems in a few other cases to be some slight variation from the biseriate type.

The form of the ascus at maturity is subject to unimportant variations, being practically identical in nearly all the genera. It varies from a somewhat stout and short type (Plate VIII, fig. 28; Plate II, fig. 11; Plate I, fig. 25) to more slender forms (Plate XI, fig. 17 and Plate XXIV, fig. 9). At the time when the spores are fully formed, the ascus is commonly short-stalked; but as the latter begins to be pushed upward by the ever-increasing mass of asci below it, the basal part often becomes drawn out into a long slender pedicel, which finally sloughs off as the ascus wall itself begins to dissolve. In almost all cases the asci are four-spored at maturity, as in the majority of the figures cited, and are distinctly flattened, the only known exceptions to this rule being presented by the two genera, Moschomyces (Plate XI, fig. 17) and Compsomyces, in both of which they are definitely eight-spored and more nearly cylindrical. The asci are never naturally discharged from the perithecium, having wholly dissolved some time before they reach the terminal pore of the latter; but by

crushing perithecia in some aqueous stain like eosin, perfect asci in various stages of maturity are very easily obtained, either free or still attached to the ascogenic cell. Before they separate from their attachment, the asci are generally much distorted by mutual pressure, but assume a more or less regular form after they have become free.

As the ascus mass or masses increase in size, their upward pressure soon destroys the superior supporting cell, as we have already seen; while their downward pressure in most instances destroys the primary and secondary inferior supporting cells, at the same time freeing the ascogenic cells from one another, if there are more than one; so that the latter eventually lie in the cavity of the perithecium, free and unconnected with any other cells. In some cases the inferior supporting cell persists after the ascogenic cells have freed themselves from their attachments, as is the case to a certain extent in Stigmatomyces, the supporting cell in this instance being so placed as to be protected by the basal cells of the perithecium which surround it. In a similar manner the inferior supporting cell in the species of Laboulbenia allied to *L. palmella* persists permanently, for the reason that it is surrounded by the lower series of wall-cells of the perithecium, which are modified to form a perithecial stalk, and corticate it completely. The further destructive action of the ascus masses on the parietal and canal cells of the perithecium has already been described in connection with Stigmatomyces.

With the formation of the spores and the disappearance of the ascus-wall, the history of the female organ and its products is completed; but, as we have seen, the changes which it has undergone are accompanied by changes in the cells of the perithecium proper which are also subject to certain variations from the course of development described as characteristic of Stigmatomyces.

In all cases the perithecium proper, by which is meant all portions of it exclusive of the female organ and its products, originates as a single cell (Plate I, fig. 10, *c*; Plate III, fig. 14, *c*) that lies wholly below the terminal cell which gives origin to the female organ in the manner above described. This cell, which has already been alluded to as the primordial cell of the perithecium, divides, in cases which have been followed out and probably in most if not in all of the other genera, into two cells more or less obliquely superposed (Plate I, fig. 11, *c′ c″*, and Plate III, fig. 15, *c′*, *c″*); the divisions of which follow in general the same course which has been described in Stigmatomyces, and may be briefly recapitulated with reference to the genus Enarthromyces. Comparing figs. 15–17 of Plate III, which represent three successive stages of development, we have in fig. 15 the condition just referred to, in which the primordial cell of the perithecium (fig. 14, *c*) has divided into two obliquely superposed cells (*c′*) and (*c″*). In fig. 16 each of these has divided, (*c″*) into the stalk-

cell (*p*) and an upper cell (*z*); while the cell (*c'*) has separated into a lower cell (*h*), the secondary stalk-cell, and two upper cells (*i, i*), only one of which is seen in the figure, the second lying opposite it on the reverse side. The two cells (*i, i*) and the cell (*z*) then continue to grow upward around the base of the primordial cell of the procarpe (*d*), and the cell (*z*) becomes separated into a lower cell (fig. 17, *o'*), the posterior basal cell, and an upper cell (*n*); while of the cells (*i, i*), one becomes separated into a lower (*o*) and one upper cell (*n*), the other into a lower (*o*) and two upper cells (*n, n*). The two cells (*o, o*) constitute the anterior basal cells, and thus, together with the posterior basal cell (*o'*), give rise to four cells (*n, n*), two only of which are seen in the optical section (fig. 17). The cells (*n, n*) in the figure cited have already grown up around the base of the primordial cell (*d*) of the procarpe, the base of which is completely enclosed, and is separated from the free portion above as a distinct cell (*f*), the carpogonium. In fig. 18, the cells (*o, o'*) have also given rise to the inner series of perithecial cells which develop as in Stigmatomyces, and are eventually all destroyed.

The free part above has in the mean time developed a terminal trichogyne (*t r*), which is separated from the carpogonium by the trichophoric cell (*c''*). The four cells (*n, n*) then continue to grow upward, and their upper portion becomes separated by a septum. This upper portion then in turn divides into an upper and a lower part, and the process is repeated several times, until the number of wall-cells characteristic of the genus has been produced. During the formation of these wall-cells a corresponding development of the inner series of perithecial cells, fig. 18 (not shown in fig. 17), has taken place, resulting in the formation of the parietal and canal-cells previously described, which correspond in number to that of the wall-cells, and, like them, are derived as upgrowths from the three basal cells (*o, o*, and *o'*).

The number of wall-cells which occur in a single row is usually four, as in Laboulbenia and many other genera, while in Moschomyces, Compsomyces and a few others, the number is five. As far as I am aware, the genus Ceratomyces (Plates XXIV and XXV) is the only one in which the number may not only vary in different species, but also in individuals of the same species. In this genus the perithecium attains in some instances a most extraordinary development, and in *C. rostratus* the number of wall-cells in a single row may reach seventy. These rows of wall-cells may be either straight, or spirally twisted, as in *Stigmatomyces Baeri*, or in some of the species of Laboulbenia (Plate XIV, fig. 27; Plate XX, fig. 19), and vary in specific cases both in form, relative size, and position. For example, in the genus Laboulbenia, the lower members of the series of wall-cells, as a rule, lie opposite the ascogenic

cells; but in some species they may lie wholly below them, being prolonged into a stalk, as in *L. longicollis*, *L. Kunkeli*, and their allies (Plate XIX, fig. 6, etc.; Plate XVIII, fig. 9). In such instances the ascus and spore masses, as they lie in the perithecium, are almost completely surrounded by the sub-basal cells of the series. In *Stigmatomyces Baeri*, on the other hand, the basal cells of the series occupy a corresponding position (Plate I, fig. 23), while in *S. virescens* (Plate VIII, fig. 2) the basal cells of the perithecium (not the wall-cells) extend up above the ascogenic cell and the base of the ascus mass. In a few cases the wall-cells may give rise to projections or definite appendages, which originate as lateral branches. Such a projection from one of the basal wall-cells is found in *Chitonomyces spinigerus* (Plate VIII, fig. 16). *C. appendiculatus* offers an example of a similar projection from one of the sub-basal cells; while instances of outgrowths from the terminal cells of the series are sometimes found, as in *Stigmatomyces virescens* (Plate VIII, fig. 1), *Laboulbenia Gyrinidarum* (Plate XXII, fig. 37), and a few other cases. In the genus Ceratomyces, multicellular appendages may be thus developed which may be even copiously branched (Plates XXIV and XXV); but in all the instances cited these structures are only of specific importance.

The terminal cells of the series of wall-cells have been already referred to as the "lip-cells"; since it is between them that the spores eventually force their way out from the perithecium. These lip-cells are often somewhat modified in shape, and are not, as a rule, similar and symmetrical, though sometimes so. They are usually modified to form a more or less elastic margin to the pore; as, for example, in some species of Laboulbenia (Plate II, fig. 14), the lip-cells of which are in general very irregular in form, and have their walls so modified as to give them great elasticity and thus regulate the discharge of spores. In this genus, and perhaps in some others, there is a peculiar structure at the apex of at least one of the lip-cells, represented in the figure just cited at (*x*), which may perhaps act as a valve, allowing the lip-cell, the cavity of which it terminates, to be more readily compressed, and at the same time to recover its form as soon as the pressure is removed. That the spore discharge may be regulated by modifications of cells other than the lip-cells has already been seen in the case of Stigmatomyces (Plate I, fig. 24); and in Sphaleromyces (Plate III, fig. 1), several sets of cells appear to assume this office. Rhadinomyces (Plate IX, fig. 13) affords an instance in which the lip-cells perform this function without any considerable modification.

Turning now for a moment to the inner series of cells which have been described as arising from the basal cells of the perithecium within, and alternating with, the wall-cells, we have seen that in Stigmatomyces their development follows that of

the wall-cells, although quite independent of it, and the same is in general true of all the genera. In forms in which, like Ceratomyces, the wall-cells become very numerous, a corresponding increase in the number of the canal-cells takes place; although the number formed may be fewer, as is indicated in Plate XXIV, fig. 8, which represents the growing apex of a perithecium in section, the divisions of the wall-cells (*w c*) being evidently more numerous than those of the canal-cells (*c c*). There seem, also, to be certain variations in the relative position of the canal-cells. In Sphaleromyces, for example (Plate III, fig. 2), the cells (*x*) are probably the lower canal-cells which have, by pushing between the wall-cells, assumed an apparently external position; and some similar modification of the more normal course of development may account for the peculiar arrangement of the cells at the tip of the perithecium in this genus, when seen antero-posteriorly as in fig. 1. It is not improbable that there are, in certain cases, variations of the course of development above described: yet in all the instances in which a careful examination has been made, it seems to correspond in all essentials.

While the wall-cells of the perithecium have a definite protective function, persisting and forming an envelope around the ascus and spore masses, and regulating and directing the dispersion of the spores; the inner series, as we have seen, performs an entirely different function which may well be compared, in so far as concerns the cells which I have called the parietal cells, to that of the so-called tapetal cells in the sporangia of the higher cryptogams; while the cells which I have called the canal-cells bear a similar resemblance in function to the neck-cells, for example, of an archegonium. It is needless to say, however, that there is not the slightest homology between the two structures in either case. The function then of the parietal cells is to make room for the developing ascus masses, and allow them to float free within the cavity of the perithecium; while that of the canal-cells is to afford a channel of exit by means of which the spores may make their way out through the pore of the perithecium. For, as we have seen in the case of Stigmatomyces, which is typical of the family generally, the growing ascus masses press upon and destroy not only their own connections with other cells above and below, but also the thin-walled parietal cells around them; while the mass of mature spores, which is constantly being pushed upward, has a similar effect upon the canal-cells, the latter, as a rule, having disappeared entirely when the spore discharge commences. In exceptional cases, as in that of Stigmatomyces, the walls of certain of the canal-cells (Plate I, fig. 24, *n c*) appear to become somewhat indurated, and to regulate, to some extent, the spore discharge; but I have observed no other instance than the one just mentioned, unless it be in the case of Sphaleromyces (Plate III, fig. 1) above alluded to.

It should be mentioned in this connection that in two genera (Dimorphomyces and Dimeromyces) not only do the parietal cells lose their individuality as cells, but also the basal cells of the perithecium, the stalk-cell, and the secondary stalk-cell; so that the cavity of the stalk-cell and that of the body of the perithecium are continuous when the latter is fully mature. In these cases, as in many other genera, the cavities of the lower wall-cells of the perithecium are gradually obliterated, as the spore mass increases; the terminal and subterminal wall-cells often being the only ones, in old individuals, in which the cell cavity can be made out.

Before leaving the subject of the derivation of the two series of cells which constitute the outer and inner portions of the body of the perithecium proper, and of their relation to the cells below, it must be confessed that my first impression concerning the origin of the inner series was that they arose from the primary wall-cells (Plate I, fig. 15, *n*), through the formation of longitudinal tangential septa, it being a matter of great difficulty to make out their exact position and relations at the earliest period of their development; and it was not till the protoplasmic connections of both the outer and inner series was observed with some exactness, in specimens of Laboulbenia the cells of which had been separated by treatment with potash, that the true condition of things suggested itself. These connections, in so far as they have been absolutely seen in given instances, are represented in figs. 16 to 18 of Plate II, which should be compared carefully with the account above given of the successive origin of the stalk-cell, the secondary stalk-cell, the basal cells, and the wall-cells; the lettering corresponding in general to that of the figures above cited on Plates I and III. In figs. 16–17 (Plate II), the parietal cells, as well as the inferior supporting cell below the ascogenic cells, had been destroyed, so that the protoplasmic connection with these cells had also disappeared; but in fig. 18, which represents a young individual, some of them were distinctly visible, and it was apparent that the inferior supporting cell (*i s*), and the two anterior basal cells (*g*) and (*d*), were definitely connected with the secondary stalk-cell (*h*), and that the two visible parietal cells (*p c*) were similarly connected with the two anterior basal cells. A second preparation showed with equal distinctness that the posterior basal cell (*o′*) was similarly connected with one of the parietal cells. It was, however, impossible to determine which of the two anterior basal cells gave rise to two and which to one parietal cell; yet it is safe to assume that the same cell (*d*) which (fig. 17) gives origin to two wall-cells, is also connected with two parietal cells. In the preparation, as will be seen (fig. 18), three connections were visible from this cell: one of which was evidently with a parietal cell, another with the wall-cell (*f*), the third running beneath and connecting on the opposite side either with

a wall-cell or with a parietal cell. The fourth connection could not be distinctly made out, and may well have been broken by the crushing which was resorted to in order to separate the cells from one another. The connections of the basal cells with the wall-cells, as they are represented in figs. 16 and 17, are very readily demonstrated. It will be noticed that in fig. 17 a portion of the posterior basal cell (*a′*), as well as its connection with the wall-cell (*i*), is indicated through the anterior basal cell (*d*), the connections of which with *two* wall-cells (*e*) and (*f*) are very distinct. The connection of the basal cell (*g*), shown in fig. 16, is not visible in this instance.

Having considered these special cases and their modifications as far as they are at present known, it may not be superfluous, even at the risk of tedious repetition, briefly to summarize the general development of the perithecium and of the structures which it contains, since it involves matters of such considerable importance that a clear understanding of it is essential.

Summary of the development of the perithecium and of the female sexual organs. The perithecium arises as a lateral, rarely as a terminal organ, and consists at an early stage of two superposed cells: an upper, which is alone concerned in the formation of the female organ, and a lower, from which is developed the perithecium proper. The upper cell elongates by terminal growth, and is converted into the procarpe through the formation primarily of two cross partitions, by which it is separated into a lower portion, the carpogenic cell, always a single cell; a middle portion, the trichophoric cell, also always a single cell, and a terminal portion, the trichogyne, which may consist of a single cell, or, through the formation of cross partitions often accompanied by copious branching, of very numerous cells. The free extremities only, of the trichogyne, are receptive, and conjugate with the antherozoids which adhere to them. As a result of this union, the trichogyne soon withers and disappears, while the carpogenic cell undergoes a series of divisions. First, by the formation of two transverse septa, it is separated into three superposed cells: the upper and lower constituting the superior and inferior supporting cells, respectively, which undergo no further changes; while the middle cell of the three, known as the ascogonium, divides, by more or less oblique partitions, into from two to nine cells, one of which lies at the base of the others and is called the secondary inferior supporting cell; while the one, two, four, or eight remaining cells are known as the ascogenic cells. Each ascogenic cell then begins at once to produce asci, which bud from it downward outward and upward, and soon becomes quite free in the cavity of the perithecium; destroying, as a rule, both supporting cells, and eventually the remains of the trichophoric cell, as well as the cells of the perithecium proper (parietal and canal cells) which lie immediately about and above it.

The cells which make up the body of the perithecium proper, all arise, on the other hand, from the primordial cell of the perithecium, which lies wholly below that of the procarpe. Its first division, with a few possible exceptions, separates it into two more or less obliquely superposed cells. From each of these cells upgrowths arise; one from the lower and two from the upper, which still retains its protoplasmic connection with the primordial cell of the procarpe. The lower becomes separated from its single upgrowth, and constitutes the primary stalk-cell; while the upper is similarly separated from its two upgrowths and constitutes the secondary stalk-cell. There are thus two stalk-cells surmounted by three upgrowths which have become separated from them and form three distinct cells, that begin to grow up around the base of the primordial cell of the procarpe. The body of each of these cells constitutes one of the three basal cells of the perithecium. From these three cells then arise eight upgrowths, four of which are external, while the remaining four are included by them and form an inner series. As a result of continued terminal growth, accompanied by the formation of a variable number of septa by which the growing tip is successively separated from the portion below, an envelope is formed which completely encloses the female organ and its products: consisting of an outer series of cells arranged in four rows, each made up of a definite number of superposed cells, which constitute the wall-cells of the perithecium; and of an inner series of cells similarly arranged, the lowest members of which have been called the parietal cells, while those above them are termed the canal-cells. Of the two series, the outer forms the perithecial wall, the inner being destroyed, with unimportant exceptions, to make room for the ascus and spore masses, and to provide a channel through which the spores may pass to their point of exit between the apposed terminal, or lip-cells, of the outer series.

General Relations and Character of the Cells. We have already seen that the gelatinous membrane which surrounds the ripe spore persists, in the growing and in the mature plant, as a general envelope within which the cells undergo their independent divisions and modifications. This envelope, though thin, is tough and very impervious, resisting the action of reagents and staining fluids in a manner which greatly increases the difficulties associated with any attempt to observe the nuclear and other changes that take place in the cells within it. In some cases it may be separated without much difficulty, by treatment with potash, or even, when the specimen is dry, by the application of water; the action in either case resulting in the swelling of the outer layers of the cell walls and the bursting of the envelope, through which the cells themselves may protrude while still connected, as is represented in Plate III, figs. 10 and 11. In other cases the envelope appears to be more firmly and intimately con-

nected with the outer layers of the cell walls, and, though always readily demonstrated by crushing, is not affected by the application of potash.

The cells of the Laboulbeniaceæ, with the exception of those which lie within the wall-cells of the perithecium, and of the receptive portions of the trichogyne, are characterized by possessing thick walls that, when treated with potash, are readily seen to consist of a number of layers, the outer of which are less dense, and soon become swollen and gelatinous. In a majority of instances they do not seem to be connected with the general surrounding envelope by any special organs of attachment; but, in certain cases, the innermost layers of the cell wall give rise to fibrillæ which, passing through the outer layers, are attached to the inner surface of the envelope. The latter, in such instances, is usually more or less conspicuously punctate, especially in cases in which it is suffused with some dark color, as, for example, in the sub-basal cell of *Laboulbenia Oberthuri* (Plate XXII, fig. 39). It may be mentioned in passing that the suffusions, usually of black or brown, which characterize many of the species, appear to be for the most part, if not entirely, confined to the envelope; the cell walls within them being, in general, hyaline.

In some cases, however, this blackening involves at least the outer layers of the walls themselves, as, for example, in the ordinary "foot." The same is true also in cases where, for instance, the septum separating two cells is thus modified. This occurs very frequently in the appendages of Laboulbenia and other genera, the blackening extending inward so that it appears to form a disc with a central perforation corresponding to the passage through which the protoplasm of adjacent cells is continuous. These blackened septa were noticed by Berlese, and described in his account of *Laboulbenia armillaris* as "black discs or rings," the nature of which was not determined.

The fibrillæ just mentioned, which, in the normal cell wall when it is viewed in optical section, give rise to the appearance described by Istvanffi as being due to the presence of "pore-canals," are more or less twisted when freed by treatment with potash, and are characterized by the presence here and there of granular thickenings (Plate III, figs. 11 and 12), their extremities being attached to the inner surface of the general envelope in a fashion that varies in different instances. In *Laboulbenia Kunkeli*, for example (Plate XVIII, fig. 9), they are characteristically attached in short rows, running transversely in the sub-basal cell, but less regularly disposed in the cells above it. In other cases they may adhere in more compact groups, as in *L. Nebriæ*, or singly without any definite and characteristic aggregation. These points of attachment tend to become dark-colored, especially in areas where the envelope itself

is suffused, and give to the latter the punctate appearance peculiar to many species. The presence of these fibrillæ has not been definitely determined in genera other than Laboulbenia, and even in this case, although so conspicuous in many species, they no not seem to be of invariable occurrence.

The substance of the cell walls as well as of the general envelope give, when treated with iodine and sulphuric acid, or with Schultze's chloroiodide of zinc solution, no blue color.

The contents of the cells, especially those of the receptacle, are usually more or less characteristic while the plant is alive, and consist of rather dense granular protoplasm, in which, as a rule, certain highly refractive spherical oily masses are conspicuous. In some instances these masses are few in number, one or more of them being often very large (Plate V, figs. 4 and 5), while again they may be more numerous and uniform in size, completely filling the cells, as in the case of *Laboulbenia Harpali*, *L. Philonthi*, and many others. In general, however, they are more or less variable in size, and present the appearance indicated in fig. 15, Plate II. In glycerine they soon become indistinguishable, and are thus not represented in the accompanying figures, which were drawn, with few exceptions, from glycerine preparations.

The protoplasm of adjacent cells, the origin of which is the same, is connected by a conspicuous strand of the same substance, which passes from one cell to the other through a well marked perforation of the cell wall, the connection being demonstrated with great ease by treatment with potash and subsequent staining (Plate III, figs. 11–12; Plate II, figs. 16–18). In many instances, also, it may be seen in the living plant without the use of reagents. This protoplasmic connection is found in all the cells, including those of the trichogyne, when this organ is multicellular. In many cases in which the cells had been separated by potash, and the connecting protoplasmic strand stretched between them, I have seen a slight enlargement like that indicated in fig. 12, Plate III, recalling the similar structure through which the strands of protoplasm pass in the Florideæ. I have, however, been as yet unable to determine its exact nature.

A single, usually large, nucleus is found in the contents of every cell, and is often readily seen without the use of reagents; while in other cases it is by no means easy to demonstrate, owing to the difficulty which is usually experienced in staining the cell contents. The nuclei are spherical or nearly so, and usually contain a large nucleolus (Plate V, figs. 20 and 24; Plate I, figs. 7, 15, 16; Plate II, figs. 3 and 13). The nuclear changes accompanying cell division have not been determined; but from the occurrence of conditions like that represented in fig. 7, Plate I, it would appear

that the nucleus divides, and that the two resultant nuclei separate before the wall is formed between them.

Although a considerable amount of time has been expended in an endeavor to determine the nature of the nuclear changes which take place in the female organ during and after fertilization, I do not as yet feel in a position to make any definite statement concerning them, and have not ventured to give any drawings of the often-conflicting phenomena observed. Any one having an opportunity to study an unlimited series of specimens of *Stigmatomyces Baeri*, for example, in a fresh condition, would probably meet with no great difficulty in determining these matters; since from the considerable size of this species, its densely gregarious habit, and the nature of its trichogyne, it is peculiarly well adapted for this purpose. Of all the Laboulbeniaceæ none, however, is better suited for study in these respects than the form described below as *Enarthromyces indicus*, by reason of its large size and great simplicity; but, as a rule, observations of this nature are made with the greatest difficulty, owing chiefly to the lack of unlimited material in the proper condition of development and the impervious character of the envelope, which so seriously interferes with the action of stains.

Abnormal Morphology and Development. In examining a large body of material, cases are often met with in which the course of development, usually characteristic of a given species, is modified in various ways, and some of these modifications are sufficiently curious to call for mention in this connection. Among the simpler instances, abnormal septation in individuals of the cells, for example, of the receptacle, frequently occur in genera like Laboulbenia, in which the latter consists, with few exceptions, of an invariable number of cells. Such an instance is represented in fig. 9, Plate XX, the basal and sub-basal cells being thus divided, while in some cases a much more complicated cell division has been observed.

An abnormal production of branches in the appendages, due, as a rule, to breakage and subsequent renewal, is very common, especially in species in which the latter are more or less filamentous, and result in an irregularity of form and branching which does not occur in normally developed plants. The multiplication of appendages, normally single or definite in number, sometimes occurs, however, not as a result of injury; as in Stigmatomyces, the normally single appendage of which is rarely furcate near the base, each branch becoming a functional appendage.

The same is true in regard to the production of accessory perithecia. While in many forms more than one is usually produced, in a majority of genera it is typically solitary. In the latter class, however, instances are sometimes met with of the produc-

tion of accessory perithecia. This abnormal condition has been seen several times in the genus Ceratomyces (Plate XXV, fig. 7), and occurs also in Chætomyces, Corethromyces, Stigmatomyces, and a few others. In Rhachomyces is found the most frequent and remarkable instance of this nature, the accessory perithecia arising in this instance in two distinct ways. In the one case, two may occur side by side as is represented in Plate X, fig. 22, or, through the proliferation of the receptacle below the base of the perithecium first formed, a second may arise a short distance above it (Plate XII, fig. 2). The same process may even be repeated, so that two or even three accessory perithecia may succeed one another, as in fig. 14 of the same plate. In the last mentioned cases the proliferation, usually, if not invariably, follows the abortion of the perithecia first formed, the trichogynes of which have, for some reason, failed to become fertilized.

One further instance of the abnormal occurrence of perithecia may be mentioned which has several times been noticed in the genus Peyritschiella. In all but one of the known species of this genus, the receptacle is terminated by a single perithecium (Plate VI) which may exceptionally be replaced by two. In the species referred to (*P. geminata*, Plate VI, fig. 7), the receptacle usually bears a terminal pair of perithecia. When, however, the individuals have grown under rather unfavorable conditions, as, for instance, near the extremities of the anterior pair of legs of their host, the lower transverse cell rows of the receptacle may give rise externally to several additional perithecia, which develop normally with the others.

To a similar failure of fertilization is also to be attributed the usually marked increase in the production of antheridia in such cases, which has been previously noted. Such antheridia are, as a rule, formed normally on the appendages; but in certain instances, on the other hand, this increase is effected by an abormal process, as a result of which, accessory antheridial branches take the place of the perithecium, growing from the cells at its base (Plate II, fig. 8). In some cases the branches produced under these circumstances may grow up through and within the atrophied perithecium, emerging between its terminal cells, as is represented in Plate II, fig. 9. A condition similar to this is figured by Peyritsch (1873, Plate II, fig. 11), the protruding filament having been mistaken by him for a trichogyne. A specimen in which a similar growth from within the base of the perithecium has resulted in the production of large numbers of branches is represented in Plate II, fig. 10. In this instance the abnormal growth had apparently followed an injury, by which the upper half of a normally matured perithecium had been destroyed. Such examples well illustrate the fact that the cell series of the perithecium proper are merely eight modified, but independent, filaments

which under abnormal conditions may be replaced by or associated with typically filamentous growths similarly derived from the basal cells.

In very rare instances individuals are met with in which a typical antheridial appendage, in a normally bisexual form, is substituted for the female organ, the substitution being accompanied by a great increase in the number of antheridia produced. An abnormal male individual of this kind is represented in Plate II, fig. 7, the two appendages being in general normal even to the formation of the blackened insertion cells.

We have seen that in general the spores are discharged in pairs, and that, as a rule, and sometimes invariably, they adhere to the host and develop side by side. It is an interesting fact which may possibly have some bearing on the derivation of the diœcious from the monœcious forms, that in certain instances one member of the spore pair may normally, or not infrequently, become atrophied, or produce a smaller and weaker individual than the other. In the case of *Laboulbenia inflata* the atrophy of one of the spores, after it has reached an inconsiderable development, seems to be an invariable rule, as far as I have had an opportunity for observation, and groups of this species, when detached with a portion of the integument on which they are growing, show the condition of things represented in fig. 5, Plate III, the atrophy being apparent even at an early stage.

Normal Variations. Like other groups of plants, the Laboulbeniaceæ are subject to normal variations in form, size, color, etc., which are partly inherent and partly due to the action of external causes. In individuals growing under identical conditions, the variations are comparatively slight, and are expressed by inconsiderable differences in gross size, or variations in the relative development of different parts, often coupled with differences in color, which are, however, in general, due to the varying age of individuals. Forms, for instance, which, when young, even when they are sufficiently advanced to discharge their spores, are hyaline or pale straw-color, may become, as their age increases, dark amber-brown or suffused, wholly or in part, with blackish or smoky-brown shades.

Among the external causes which influence variation, the most important are associated with the character of the host, its size, and the position in which the parasite grows upon it. The color of the host, for example, often influences that of the parasite, the same species being sometimes very dark or nearly opaque on hosts with a dark or black integument, while they are pellucid, or nearly hyaline, on hosts of a lighter color, such differences in color being independent of differences in the age of the individuals in question.

Variations in size among different specimens of a given species are often influenced by two factors, namely, the size of the host and the position in which the parasite has become attached. Thus small specimens of a given species of insect will, as a rule, bear smaller parasites than larger ones, and the same is true of smaller species in a varied genus, for example, like Platynus, almost all the members of which are liable to be infested by a single species of Laboulbenia. In regard to differences dependent on the position of growth, it is usually true that individuals growing near the circulatory centres of the host, being presumably better nourished, are commonly distinctly larger. The largest individuals that I have observed, for example, have been found growing on the thorax or prothorax about the base of the two anterior pairs of legs, while, on the same insect, those which inhabit the tips of the elytra, or of the legs, include the smallest specimens. It should also be observed that individuals growing in situations in which they are exposed to the most unfavorable conditions are apt to be thick-set, short, and stout, with short appendages. This is true, for example, in specimens of *Laboulbenia elongata*, *L. subterranea*, and various other species, when they occur, as they not infrequently do, on the mouth parts or near the tips of the legs of their hosts, the difference in general habit in such cases being often so great that such forms might easily be mistaken for distinct species. The same short, stout habit, it may be mentioned, characterizes species which are found normally in such situations and not elsewhere; as, for instance, in the case of *Laboulbenia parvula*, *Peyritschiella minima*, and others, that are, as a rule, found near the extremities of the legs, and only exceptionally in other situations.

The *rate of growth* of the Laboulbeniaceæ and the *duration of their life period* are matters concerning which it is not easy to make exact observations, owing, on the one hand, to the difficulty of obtaining freshly hatched hosts that have not been exposed to infection, and, on the other, to the uncertainties connected with the determination of the exact time at which the infection of the fresh hosts is accomplished. By keeping in confinement insects which have been collected with spores upon them just germinating and distributed on definite areas, one may estimate with considerable accuracy the time necessary for the fungus to reach maturity. This period, in the species of Laboulbenia which I have thus cultivated, has proved to be from two to three weeks. It is doubtless variable, however, in different genera; those which are more complicated in structure requiring, for their full development, a period correspondingly longer; as may well be the case, for instance, in Rhachomyces or Zodiomyces. According to Peyritsch, freshly hatched flies confined with others infested by *Stigmatomyces Baeri* were found to bear mature individuals of the fungus in from ten to four-

teen days, according to the temperature at which they were kept; and it is certainly improbable that many forms attain maturity in a much shorter period than this.

In regard to the *longevity* of individuals, it seems quite certain that those which have been mature in the autumn, may still produce spores during the spring and early summer; for although mature specimens which have hibernated are apt to be much damaged, and are often no longer fertile, fully mature individuals, evidently of considerable age, from their dark color, have been found on hosts still hibernating and collected by "sifting" early in the spring before the advent of warm weather. That the germinating spores and young individuals live over winter, attached to their hosts, in a dormant condition, is an undoubted fact; and it is upon the survival of these, rather than on that of the maturer individuals, that the fungus depends for its perpetuation. That a majority of forms, occurring in temperate climates, live throughout the summer and early autumn cannot be doubted; since one very rarely finds individuals that are old and infertile. When such cases occur, with few exceptions (as in Amorphomyces), the cessation of fertility has evidently resulted from some violent injury which has destroyed the perithecium, or a portion of it. From my own observations in this connection, I think that it may be safely assumed that, in a majority of cases, the life period of the parasite coincides with that of the host. The number of spores formed by a single individual must therefore be often enormous, in view of the fact that the ascogenic cells are continuously active during the growing season.

GEOGRAPHICAL DISTRIBUTION. Any intelligent discussion of the distribution of the Laboulbeniaceæ is hardly possible, since it is in North America only that their systematic study may properly be said to have commenced; yet, judging from the small number of exotic hosts which have been available for examination in connection with the preparation of the present monograph, it may be inferred that the warmer portions of the earth are quite as rich in representatives of the group as are the more temperate regions, while towards the colder northern latitudes they become distinctly less abundant. For, although specimens have been examined from localities as far north as Hudson's Bay and the Aleutian Islands, a comparatively small percentage of the hosts collected in these regions appear to be infested, while the reverse is true as the southern portion of the United States is approached. Notwithstanding the fact that the Carabidæ and Staphylinidæ, families of beetles which furnish by far the majority of the hosts at present known, are relatively much less abundant in tropical than they are in temperate regions, it seems highly probable that, in such localities, these orders are replaced by numerous other insects having suitable life-conditions, among which

orders other than Coleoptera are doubtless largely represented. This is indicated by the fact that two among the small number of tropical forms at present known occur on such peculiar and unusual hosts as those of *Laboulbenia armillaris* and *L. Hageni*, the one a mite, the other a white ant. Southern California also furnishes an instance of the occurrence of a peculiar form on a host, Chilocorus, quite unrelated to any of the usual genera of insects thus parasitized, and it must be remembered that the Diptera have hardly been examined at all in this respect. It thus seems not improbable, in view of the above facts, and of the more favorable conditions for development and perpetuation which exist in the warmer regions of the earth, that we may look to them for a large, if not the largest, future addition to the group; for that the family is destined to be greatly augmented can hardly be doubted.

Including a small number of forms not enumerated in the succeeding pages, from lack of proper material for description, the total number of Laboulbeniaceæ known at present to exist includes one hundred and fifty-eight species, from which five perhaps might well be deducted as synonyms, distributed among thirty genera, three of which are undescribed. Of these one hundred and thirteen are, so far as known, confined to North America, eleven to Europe, eight to Africa, three each to Asia and South America, including Panama, while two are peculiar to Australia. On the other hand, nine are common to North America and Europe; two to North and South America; one to North America, Europe, Asia, and probably to Africa; one, the determination of which is perhaps doubtful, to North America, South America and Africa, including Madagascar; one to South America and Africa; one to North America, Europe and probably to Asia; and, lastly, one to Africa and Asia (Japan).

Turning to the genera, one finds that of the twenty-five which are known in North America, twenty are not recorded from other continents; that of the six genera known in Europe, two have not been found elsewhere; that of four genera known from Africa, two are indigenous; while of the two Asiatic genera, one is confined to that continent. Lastly, South America and Australia are each known to possess but the single genus Laboulbenia, which is universally distributed.

It is needless to remark that these statistics have little or no value as showing the actual relative distribution of the species and genera in the several continents, and they are merely given to indicate the possibilities of distribution in so far as our imperfect knowledge will permit. For convenience of reference a table giving in more detail the facts of relative distribution outlined above is here appended: —

Total number of species known to exist					158
"	"	"	"	described	152
"	"	" North American species described			124
"	"	" North American species known			130
"	"	" European species			19
"	"	" African species			14
"	"	" South American species			6
"	"	" Asiatic species			6
"	"	" Australian species			2

Common to North America and Europe. — *Chitonomyces paradoxus*, *Rhadinomyces pallidus*, *Laboulbenia elongata*, *L. cristata*, *L. Gyrinidarum*, *L. luxurians*, *L. Nebriæ*, *L. subterranea*, *L. vulgaris*.

Common to North America and South America. — *Laboulbenia Guerinii*, *L. variabilis*, *L. polyphaga*.

Common to North America and Africa. — *Laboulbenia Catascopi*, *L. polyphaga*, *L. elongata* (?).

Common to South America and Africa. — *Laboulbenia Pheropsophi*, *L. polyphaga*.

Common to Africa and Asia (Japan). — *Laboulbenia proliferans*.

Common to North America, South America, and Africa. — *L. polyphaga*.

Common to North America, Africa, Europe, and Asia. — *Laboulbenia elongata*.

Common to North America, Europe, and Asia (?). — *Laboulbenia vulgaris*.

In regard to the distribution of single species in a given continent no data are available in any case except that of North America, where a wide distribution of given species is indicated. The common *Laboulbenia Nebriæ*, which is also known to occur in Europe, is found in America from Maine to Virginia, and west to Washington, extending northward to Alaska and the Aleutian islands. *Laboulbenia cristata* is another instance of a European form which is found in this country from Maine to Nicaragua, and several examples might be mentioned of species found throughout the United States and Mexico. The writer has unfortunately had no opportunity of collecting Laboulbeniaceæ on their living hosts outside of New England, and it is only in this limited territory that an approximate knowledge of their local distribution has been obtained; yet in general it may be safely assumed that the different species have a range practically coincident with that of their usual hosts. The occurrence of more or less cosmopolitan forms, like some of those mentioned above, which are doubtless more numerous than our present knowledge would indicate, has a certain interest when we consider that the possibilities of dissemination are so restricted as is necessarily the case where, as in the present instance, direct transfer from one living host to another is an essential factor in the perpetuation of the species. Of the more local occurrence of the Laboulbeniaceæ nothing further need be said at present, since, as has just been mentioned, it coincides with that of the special hosts of the group, which will be presently referred to.

Hosts of Laboulbeniaceæ. According to our present knowledge all members of the family are entomogenous, and occur only upon members of the orders Coleoptera, Diptera, and Neuroptera, with a single instance found among the Arachnida. Peyritsch in his third paper refers to an observation recorded by Hagen, where he does not state, of the occurrence of a member of the family on one of the Orthoptera; and although this must be considered of doubtful authenticity, it seems more than probable that others of the insect orders, especially the Hymenoptera, may prove to be similarly parasitized. It will be noticed in the appended host index that coleopterous hosts outnumber very greatly all others; yet it should be borne in mind that this predominance of beetles in the list may be due in part to the fact that no other group has been examined with any care in this connection. The known occurrence of species on such diverse insects as the delicate fly Drosophila, the larva of a white ant, and the acarid Antennophorus, certainly suggests many possibilities as to the types of hosts likely to be affected. There seems no good reason, then, why a much greater variety of insects than are at present known should not be added to the list, especially from the tropics, provided that they fulfil the apparent requirement of overlapping generations and moderate longevity, coupled with a cleanly and not too solitary habit.

The relative numbers infesting the various orders and families of insects may be seen at a glance from the following table, which includes all forms known to the writer, whether described or otherwise, and is approximately correct, though not absolutely so, in so far as regards the number of the undetermined species of hosts.

Table of Host Insects of Laboulbeniaceæ.

Total number of species of insects known to become the hosts of members of the Laboulbeniaceæ	250
Total number of genera represented by these hosts	86
Total number of hosts belonging to the order Coleoptera	241
Total numbers of hosts in the different families of this order: —	

Carabidæ	genera 47;	species, 156
Haliplidæ	" 2;	" 2
Dytiscidæ	" 3;	" 8
Gyrinidæ	" 3;	" 15
Hydrophilidæ	" 4;	" 9
Staphylinidæ	" 18;	" 50
Coccinellidæ	" 1;	" 1

Total number of hosts belonging to the order Diptera	6

Total numbers of hosts in the different families of this order: —

Nycteribidæ	genera, 3;	species, 3
Diopsidæ	" 1;	" 1
Drosophilidæ	" 1;	" 2
Muscidæ	" 1;	" 1

Total number of hosts belonging to the order Neuroptera 1

A single family Termites . . . . genus, 1; species, 1

Total number of hosts belonging to the order Arachnida 1

A single family Gasmidæ . . . . genus, 1; species, 1

In comparing the species and genera represented by these hosts it is noticeable that although the Carabidæ exceed all other families as regards the number of genera and of species, both of hosts and parasites, the number of genera by which they are infested is comparatively small. Of the seventy-five species of Laboulbeniaceæ which are found on members of this family, sixty-five belong to the single genus Laboulbenia, while the remaining ten are distributed among but five genera, Dimeromyces, Peyritschiella, Enarthromyces, and Rhachomyces. In the case of the Staphylinidæ, however, which, next to the Carabidæ, includes more hosts than any other family, the proportions in this respect are quite different. For although the genus Laboulbenia predominates to such a degree in the Carabidæ and infests all of the orders, and a majority of the families given in the above table: among the fifty species known on members of the Staphylinidæ, but four belong to this genus, while the remaining forty-two are distributed among no less than eighteen genera. The last mentioned family is thus by far the most interesting in this connection, and its parasites abound in peculiar forms.

It is further observable that the aquatic hosts, with the exception of the Gyrinidæ, the species of which swim on the surface of the water and carry their hosts at least partly exposed to the air during much of their existence, are infested only by members of the three genera Zodiomyces, Ceratomyces, Hydraeomyces, and Chitonomyces, of which the two first mentioned are the only representatives of the group of "exogenæ," producing their antherozoids exogenously.

In general, it is true that among the Coleoptera infested a majority are either riparian or aquatic in their habits; yet there are a number of forms that occur upon insects which live away from the water and often inhabit rather dry situations. Of these, Chilocorus is perhaps the best example; while, outside the Coleoptera, the common house-fly affords a conspicuous instance of a host very subject to this parasitism, yet far from riparian in its habit. Peyritsch notes the fact that, in his experience,

hosts inhabiting the margins of running water were much more likely to be parasitized than those found along the borders of ponds or of still water generally; but this has certainly not been my own experience, and the margins of ponds or of boggy places generally have always proved as rich in Laboulbeniaceæ as those of brooks or rivers. It is also worthy of note that the statement made by the same author that iridescent hosts are not infected has not proved to be true in my experience.

The relation of the parasite to its host as regards its nutrition has already been referred to, and there can be no doubt that the fluids of the insect are absorbed by osmosis through the membrane of the foot or haustorium, whether this be a highly developed penetrating organ, as in Rhizomyces or Moschomyces, or consists merely in a sucker-like external attachment.

The relation of the parasite to its host, in position, is a matter of interest for several reasons; for, although all parts of the latter may be infested, the antennæ, the eyes, the mouth parts, the anal plates, — in fact any portion exposed when the insect is at rest, — certain species exhibit a very remarkable definiteness in regard to their point of attachment. In some forms, like *Laboulbenia Nebriæ*, or *L. Galeritæ*, the parasite occurs indiscriminately all over the host; others, like *L. terminalis*, *L. fumosa*, or *L. luxurians*, only at the tips of the elytra and the adjacent region about the extremity of the abdomen. Others, like *L. parvula* and *L. arcuata*, have been found only on the legs, the latter species always in a definite position. *L. Harpali*, again, occurs on one side only, along the anterior inferior margin of the thorax and the adjacent margin of the prothorax. *L. contorta*, *L. umbonata*, *L. elegans*, *L. lepida* and *L. texana* all occur, with very rare exceptions, on the prothorax just below the external margin, usually on a definite side; and it may be noted in passing that, especially as regards the extremity of the perithecium, all the last-mentioned species have a family resemblance. Instances like those just enumerated might be multiplied; but by far the most remarkable examples occur in the genus Chitonomyces. Species of this genus growing, for example, on *Laccophilus maculosus*, can be distinguished, as a rule, with certainty merely by noting their relative positions. *C. paradoxus* is invariably fixed to the margin of the left elytron about half-way between its base and apex; *C. marginatus* occurs just within the margin of the same elytron nearer the apex. *C. lichanophorus* is found only on one of the inferior median anal plates (always the same plate), and so on through the list of twelve species that infest this host; the only instance which I have noticed of any deviation in their position being in the case of *C. marginatus*, which is rarely found attached to the left posterior leg.

Why such constancy in position should exist in some cases, and not in others, is a

matter that I am wholly unable to explain. It is certainly not connected in any way with matters of nutrition, and although it may be in part explained as resulting from the fact that the spores are transferred while the sexes are *in coitu*, and the points of infection are determined by definitely recurring motions of the legs or otherwise, this does not seem sufficient to explain the constancy of the phenomenon. Peyritsch (1875), calls attention to the fact that *Stigmatomyces Baeri* invariably occurs on the under surface of the male and on the upper surface of the female host. Such a fact, if it were true, would readily be explained in this way. My own observations, however, do not agree with those of Peyritsch in this respect, though this relative position may perhaps be the more common.

That certain types of form are associated with certain types of hosts seems to be a fact illustrated in a limited number of instances, — a well-marked case being afforded by the species of Laboulbenia which are found on Clivina and its near allies, and those which occur on Galerita and related forms. The species of Laboulbenia which inhabit water beetles also furnish a case in point.

Parasites of Laboulbeniaceæ. In examining a very large amount of material I have been struck by the general absence of parasites attacking these fungi. A very small number of such parasites do, however, occur, the most striking of which belong to two forms of an apparently new genus of the Chytridineæ, which grow externally on species of Ceratomyces, possessing well-developed filaments and large appendiculate zoosporangia. The only other parasite which seems at all peculiar to the order is a minute organism, perhaps a yeast, that often completely envelopes the appendages, especially of species of Laboulbenia, assuming a characteristic semi-lunar form. The same organism sometimes makes its way into the interior of the perithecium, filling it and destroying its contents.

Parasites associated with the Laboulbeniaceæ, and, like them, attached to living insects, are more or less abundant; and while the majority are animal in nature (bell animalcules, rotifers, etc.), there is one genus of fungi (?), unknown to me, which, though quite colorless, resembles some of the more simple chlorozoosporic algæ. It is attached to the insect (and sometimes by accident to specimens of the Laboulbeniaceæ) by a slightly blackened base, and consists of about three superposed cells, the upper of which produces a small number of apparently non-motile spores endogenously, that escape through a terminal opening.

The genus described as Devoea,[1] which is evidently not in any way "related to

[1] Lockwood, S. Fungi affecting fishes. Jour. N. Y. Microscop. Soc. Vol. VI., p. 67 (1890).

the Saprolegniæ," but seems to be an encysted condition of some protozoan or other animal organism, is also not infrequently found on water beetles.

The collection of Laboulbeniaceæ involves little more than the collection of a sufficient number of the proper hosts, although their presence on the latter is not always easy to ascertain in case of the smaller forms. In so far as concerns the collection of hosts, my own experience, which is not that of a skilled entomologist, much less of a coleopterist, indicates that the most favorable localities in which to search for infested beetles is along the margins of small streams or of ponds. In such situations abundance of hosts may usually be found under stones or sticks, or in rubbish, that may be best shaken over a sheet or other white cloth, on which the insects are readily captured. Traps deposited in such situations, and made by raking together a heap of decaying grass, algæ, etc., often yield large numbers of interesting specimens when examined in this way. Many forms may also be obtained by leaving bundles of hay or grass in cultivated ground for a few days and examining them over a sheet. Water beetles are in general best obtained by sweeping the margins of ponds or ditches with a dip net; those bearing Zodiomyces occurring in cool gravel along the margins of brooks, or in cold, wet rubbish which has accumulated on rocks or branches in its bed. Staphylinidæ which are either mycophagous or fimicolous have not been found to yield any parasites. Forms of this family most likely to be infested are best obtained by using the two kinds of traps above mentioned. The collection of hibernating specimens by "sifting" seldom yield parasites in good condition. A few hosts may be obtained on flowers: *Harpalus pennsylvanicus*, for example, which is very commonly infested, is usually found in abundance climbing up the spikes of *Ambrosia artemisiæfolia* about dusk.

Laboulbeniaceæ may be "cultivated" in the manner above alluded to, by confining infested hosts with such as are free from any parasites; and this is not a matter of any considerable difficulty, provided that surroundings are furnished which are suited to the habits of the insects employed. If pains are taken to keep these surroundings moist and fresh, the parasites will develop normally; but if there is not sufficient moisture to allow of a certain amount of condensation on the surface of the hosts, fertilization is apt to be interfered with, and, as a result, one finds a large number of abnormal and undeveloped forms. As a rule, it is more satisfactory and quite as little trouble to obtain specimens that have grown under natural conditions, and little, if any, advantage is to be obtained from such artificial cultivation.

No attempt has been made to cultivate the spores in artificial nutrient media, and the results which might be looked for from such cultures, even if they should prove

to be possible, which I very much doubt, are not likely to afford data which could not be as well or better observed by the examination of successive stages in individuals naturally developed; except, perhaps, in so far as concerns the possibilities of monstrous development which these plants might exhibit under such unnatural conditions.

Preparation of Material for Examination. Having obtained a number of hosts which are liable to be parasitized, it will found that from about five to fifty per cent. will bear parasites. In order to obtain them for examination, the host should be killed and impaled on a fine needle (a No. 12 sewing-needle mounted in a match is the most convenient), care being taken that the surface of the insect remains perfectly clean and dry, and then examined over a dull white, and then over a black surface with a hand lens magnifying about eight or ten diameters, a dissecting microscope being most conveniently used for this manipulation. Every portion of the insect should be examined in different positions, and when the parasites have been discovered, they should be removed by means of a dissecting needle like that just mentioned, the needle having been inserted in the match far enough to give it the requisite stiffness, while its apex should have been ground on a fine oil-stone until a sharp, slightly oblique chisel point has been obtained. With such a point, the individuals are scraped off without much difficulty, and should be transferred to a very small drop of water on the slide. When the desired number have been thus transferred, the individuals may be conveniently arranged by means of a fine hair mounted like the needles. The excess of water should then be drawn away from the specimens with a shred of blotting paper, and as soon as the moisture has dried around them, they should be quickly treated with alcohol, and covered with a cover glass which should always be supported by a shred of blotting paper or a chip of cover glass. The alcohol should then be replaced by water, as quickly as possible, when the individuals will be found still living, if the manipulations have been sufficiently rapid, and attached to the surface of the slide as a result of the slight drying just mentioned. Although these directions may seem superfluous, it will be found that if they are accurately followed, much trouble and the loss of many specimens will be avoided. For permanent mounting, I have used only glycerine, to which is best added a small amount of a saturated alcoholic solution of eosin, together with a trace of common salt. This preparation is very satisfactory for general purposes, and should be allowed to run under the cover glass and replace the water slowly, as it evaporates. If the replacement is too rapid, the individuals will become shrunken, but generally regain their normal form in a few days, or in a much shorter time.

Dried material for herbarium specimens, which is always sufficiently good for

purposes of determination, should be mounted in tight pill-boxes on the herbarium sheet, to avoid the depredations of Anthrenus and other pests of insect collections. A little cotton in the box prevents the host, as well as its parasites, from being injured by falling about when moved. Care should also be taken that the insect is kept clean and free from dust particles or exudations from its own body. Otherwise, it is often difficult or indeed impossible to detect the parasites when needed for examination.

PART II.

NOTE CONCERNING THE SYSTEMATIC POSITION OF THE LABOULBENIACEÆ.

The systematic position of the Laboulbeniaceæ has been a matter of much uncertainty, and even in the light of a fuller knowledge, both of the forms and of their development, it still remains undetermined what are their immediate connections within the group of Ascomycetes to which they must undoubtedly be referred. As we have seen, Montagne and Robin (1853), who were the first to describe them as plants, speak of the single genus then known as "e familia Pyrenomycetum novum genus," and compare it to Capnodium, although they made no observations on the origin of the spores. Later, Karsten, who first included them in the Mucorini (1869), places them (1895) in a group of "Stigmatomycetes," between the Ustilagineæ and the Pyrenomycetes; but although this author correctly observed the essential fact of the occurrence of fecundation, he denies the presence of asci, and gives a quite erroneous account of the spore formation. Peyritsch (1871, 1873), although his observations on the process of fecundation were incorrect, was the first to present any definite evidence of their ascomycetous nature; yet it seems doubtful whether asci were seen even by him, since his reference to them as "eight to twelve spored" indicates the correctness of the criticism made by Karsten, who held that these "asci" were merely the ordinary aggregations of spores, coherent in a fusiform mass, as is their wont, and surrounded by their own gelatinous envelopes, which were mistaken for the ascus wall. This element of uncertainty in the observations of Peyritsch led De Bary to place the group among his "Doubtful Ascomycetes," a disposition in which he has been followed by most systematists who have alluded to the group at all. In any case, it is at present definitely determined that asci, containing four or very rarely eight spores, always occur; and that they are beyond question the morphological equivalents of the corresponding structures in the Ascomycetes generally. It further seems undeniable that these bodies are of sexual origin, in view of the evidence adduced in the foregoing pages. If, then, we admit both the sexual and the ascomycetous nature of these plants, their consideration becomes a very important factor

in any attempt to trace the homologies of the ascus or the derivation of the group of Ascomycetes in general.

It is not my intention in this connection to enter into any detailed discussion of the several theories which have been advanced in regard to these matters; yet they cannot be allowed to pass unnoticed. In brief, it may be said that, as regards the primary origin of the Ascomycetes, authorities seem generally agreed in deriving them, in an ascending series, from the Phycomycetes; but in the discussion of the homologies of the reproductive organs in either case, the agreement has not been so striking. De Bary, as is well known, relying in a great measure on his observations in regard to the development of Sphærotheca, as well as on the account given by Eidam of his genus Eremascus, finds little difficulty in homologizing (with his usual judicious cautiousness of statement) the asci of these genera with the oogonia of the Phycomycetes; while their sexual derivation was further substantiated through the studies of Janczewski and others on Ascobolus, by those of Kihlman and others on Pyronema, by those of Stahl on the Collemaceæ, as well as by further observations which need not be here enumerated. In later years there has been a reaction from this view, for the most part due to the very important, yet unconvincing, researches of Brefeld. This writer, by the accumulation of a large amount of wholly negative evidence, having discarded as without significance the positive evidence just referred to, presents an argument from which he concludes that although the Ascomycetes have originated from the Phycomycetes, they have lost all traces of sexual organs. According to this view, the ascus is assumed to be merely a modified non-sexual sporangium, homologous with the non-sexual sporangia of the Phycomycetes; and an attempt is made to substantiate this assumption by the citation of a series of examples which, in his opinion, illustrate the actual process of evolution by which this transformation has been brought about.

In still more recent years, observations made by Dangéard on the phenomena of nuclear fusion in the Ascomycetes and elsewhere, prior to spore formation, have led this writer to believe that oosporic sexuality, thus expressed, is general among the higher fungi, including the group in question; a view which, for reasons that need not here be considered, does not seem to call for serious consideration.

It is thus apparent that the question under discussion has resolved itself into the phyllogeny, not of the Ascomycetes, but of the ascus; one "school" asserting its non-sexual character, the other the reverse. Supporters of the former contention, like Van Tieghem, for example, seeing in the trichogyne of Stahl a remarkably developed "ventilating apparatus," or in the "carpogonium" of Ascobolus or Pyronema, a

group of merely vegetative cells charged with nutriment destined for a special purpose. Others, again, believing that the organs described are sexually significant, consider them, in many cases, functional, while in others, they may have lost their sexual character or have disappeared entirely; the presence among the Ascomycetes of purely apogamic forms being as readily reconciled with the coexistence of sexual forms as it is among the Phycomycetes, where a similar degeneration to an apogamous condition is well known to exist in not a few instances.

Recent investigations, however, embodied in the very important paper on Sphærotheca lately published by Dr. Harper,[1] indicate that while De Bary, who may be considered the chief exponent of the view last mentioned, was correct in his general observation as to the existence of sexual reproduction in connection with the formation of the ascus in this plant, he was misled by his failure to observe the very significant phenomena exhibited by the changes which take place in the carpogenic cell after its fertilization. These phenomena, which consist in the production of a series of superposed cells, only one of which, and that not the terminal one, enlarges or buds out to form the solitary ascus, forbid any such direct comparison as that suggested by De Bary, between this single ascus and the oogonium of the Phycomycetes. It seems not unlikely that further and more exact observations on Eremascus may lead to some similar modification of the course of development described by Eidam; and in any case, in view of the absence in one or in both of these instances of such evidence as they were thought by De Bary to afford in support of his own views, and the, to myself at least, wholly unconvincing character of the arguments and illustrations presented by Brefeld in support of his peculiar theories, one seems justified in suggesting at least the possibility of an origin for the Ascomycetes quite different from that assumed by either of these authorities. In my own opinion, the comparison made by Harper, in the paper cited, between the sexual process therein described and that of Nemalion, though it might seem at first sight hardly warrantable, becomes distinctly justified when one places between these two instances that of the present group.

If, on the one hand, we compare the Laboulbeniaceæ with the Florideæ, a very distinct agreement is apparent between them as regards their mode of growth and general structure; while this comparison is also suggested by the gelatinous envelope and the conspicuously developed continuity of the protoplasm between adjacent cells within it. The development of the perithecia in the one case finds a parallel in that of certain cystocarps, and the type of sexual reproduction in either group is essentially identical.

[1] Ber. d. Deutsch. Bot. Gesell., Vol. XIII, p. 475 (1895).

If, on the other hand, the group is compared with the ascomycetous fungi, one finds that the differences in general structure are apparent and not real, the vegetative body consisting of a septate filament which elongates and branches in a definite fashion within a general enveloping membrane. The thallus is thus not essentially different in the two cases, and the perithecium of the Laboulbeniaceæ is exactly comparable to the corresponding structure in other Ascomycetes, like Sphærotheca for example; the process of formation in either case involving the enclosure of a female cell, through the upgrowth around it of filaments originating below its base. It is further unquestionably true that its sexual organs and sexual reproduction are strictly homologous with the corresponding structures and phenomena that have been described in the Collemaceæ, in Ascobolus, in Sphærotheca, and in other instances. Lastly, the products resulting from this sexual process, the asci and ascospores, are identical and homologous with those similarly resulting in the cases mentioned.

That the Laboulbeniaceæ greatly resemble the Florideæ may then be inferred from the general structure of its members, its sexual phenomena, and the development of its sporocarps and asci, resemblances which, it may be added, are coupled with an aquatic or sub-aquatic habit. That it belongs not among the algæ, but among the fungi, is indicated by the absence of chlorophyl and of true cellulose in its cells, coupled with a parasitic habit; while the products of its sexual reproduction, the asci and ascospores, are those of fungi and by no means of algæ.

In view of these facts the derivation of the Ascomycetes through the Laboulbeniaceæ from some branch of the Florideæ seems a supposition not unworthy consideration, and although personally I regard such a suggestion as a mere speculation, I must confess that if one must have a theory of derivation in this case on a basis of ascertained facts, an origin of the nature above indicated is in my own opinion more probable as well as more logical than that which is usually held: since the latter involves the, to my mind, improbable assumption that a parasitically degraded series has attained, by a parallel course of upward development, the same goal which has been reached by the carposporic algæ; the alternative, on the other hand, involving the consideration of the fungi as a heterogeneous group derived through degeneration at different points from types already elaborated in the algal series.

Speculations of this nature are, however, of little value in the absence of facts by which they may be substantiated; yet if the origin of the family from the Florideæ is, to say the least, problematical, it is almost equally a matter of conjecture if one attempts to determine their exact point of union with the Ascomycetes in general. While their color, gelatinous consistency, and entomogenous habit might suggest a

remote relationship to the Hypocreaceæ, it is worthy of note that the bodies most nearly resembling the characteristic antheridial cells found in the family are the "Hyphopodies mucronées" of the Meliolæ; but having as yet been unable to examine the latter in a fresh condition, I can at present merely suggest the possibility of a similarity of function.

In arranging the genera under which are grouped the species included in the following systematic enumeration, the primary divisions have been based on the characters of the male sexual organs. Forms having antherozoids exogenously produced, have been separated in a group of "exogenæ," comprising but two genera, while the remaining twenty-six genera having antherozoids that are produced endogenously, are placed in a second group of "endogenæ."

The two genera of the first-mentioned group are both primarily aquatic, and if we entertain the suggestion that the family has been derived from carposporic algal ancestors, might, from their simple antheridial branches and their aquatic habit, be considered as probably the more primitive of the two groups. Of this group, the genus Ceratomyces may be taken as the type, since it illustrates most clearly not only the exogenous formation of antherozoids, but the indeterminate development of the perithecia and their tendency towards an appendiculate condition.

The twenty-four genera of the second group offer many difficulties, if one attempts to arrange them in lineal sequence; but here again the character of the male sexual organs affords a natural means for their general separation into two groups, characterized in the one case by the presence of what have been previously described as "compound," in the other of "simple" antheridia, and these again may be subdivided according as the sexual organs occur on the same or on different individuals.

A further subdivision has been employed in the following synopsis based upon the determinate or indeterminate arrangement of the antheridial cells; but this disposition, while it expresses, in a measure, true relationships, by bringing together such genera as Idiomyces, Stigmatomyces, and Helminthophana, is not wholly satisfactory. Further than this, a definite arrangement into not too numerous sub-groups is hardly possible, although it is evident that genera like Moschomyces, Compsomyces, and perhaps Sphaleromyces, or Teratomyces and Diplomyces should go together. A more definite appreciation of their further relationships will no doubt become possible after the discovery of additional genera; but at present it would be quite superfluous to attempt to represent them graphically.

GENERAL SYNOPSIS OF THE GENERA AND SPECIES WITH THEIR HOSTS.

Family LABOULBENIACEÆ.

GROUP I. Endogenæ. Antherozoids produced endogenously.

Order I. Peyritschielleæ. Antheridial cells united to form a compound antheridium.

A. Diœcious.

Genus I. Dimorphomyces. Perithecia and appendages borne in pairs to the right and left of the median line.

(1) **D. denticulatus** Thaxter, on *Falagria dissecta* Er., N. America.

(2) **D. muticus** Thaxter, on *Falagria dissecta* Er., N. America.

Genus II. Dimeromyces. Perithecia and appendages in a unilateral series.

(1) **D. africanus** Thaxter, on *Pachyteles luteus Hope*, Africa.

B. Monœcious.

* Antheridium borne on an appendage free from the receptacle.

Genus III. Cantharomyces. Antheridium lateral below a terminal branch of the appendage. Perithecia free.

(1) **C. Bledii** Thaxter, on *Bledius assimilis*, N. America.

(2) **C. occidentalis** Thaxter, on *Bledius armatus* Er., N. America.

(3) **C. pusillus** Thaxter, on *Trogophlœus* sp., N. America.

Genus IV. Haplomyces. Antheridium terminal tipped by a spine-like process. Perithecia free.

(1) **H. californicus** Thaxter, on *Bledius ornatus* Lec., N. America.

(2) **H. texanus** Thaxter, on *Bledius rubiginosus* Er., N. America.

(3) **H. virginianus** Thaxter, on *Bledius emarginatus* Say, N. America.

Genus V. Eucantharomyces. Antheridia terminal with a neck-like terminal canal, the antheridial cells in five (?) vertical series. Perithecia free.

(1) **E. Atrani** Thaxter, on *Atranus pubescens* Dej., N. America.

Genus VI. Camptomyces. Antheridium terminal with a prominent apical pore. Antheridial cells in two (?) vertical series. Perithecia free.

(1) **C. melanopus** Thaxter, on *Sunius prolixus* Er., *S. longiusculus* Mann., N. America.

** Antheridium sessile on the body of the receptacle, sharply pointed.

Genus VII. Enarthromyces. Receptacle a single series of superposed cells with one or more lateral antheridia. Perithecia free.

(1) **E. indicus** Thaxter, on *Pheropsophus* sp., Asia.

GENUS VIII. PEYRITSCHIELLA. Asymmetrical receptacle consisting of several superposed transverse series of cells above its one or two basal cells; antheridium single, lateral. Perithecia free.

(1) **P. curvata** Thaxter, on *Platynus cincticollis* Say, N. America.

(2) **P. minima** Thaxter, on *Platynus cincticollis* Say, N. America.

(3) **P. geminata** Thaxter, on *Pterostichus luctuosus* Dej., *P. patruelis* Dej., *P. erythropus* Dej., N. America.

(4) **P. nigrescens** Thaxter, on *Philonthus debilis* Grav., N. America.

GENUS IX. DICHOMYCES. Symmetrical receptacle of several superposed transverse series of cells, the basal cell single; a pair of antheridia on the subterminal series. Perithecia free.

(1) **D. furciferus** Thaxter, on *Philonthus debilis* Grav., N. America.

(2) **D. inæqualis** Thaxter, on *Philonthus debilis* Grav., N. America.

(3) **D. infectus** Thaxter, on *Xantholinus obsidianus* Melsh., N. America.

(4) **D. princeps** Thaxter, on *Philonthus sordidus* Grav., N. America.

GENUS X. HYDRÆOMYCES. Receptacle asymmetrical, its distal portion united to the perithecium; its three basal cells superposed. Aquatic.

(1) **H. Halipli** Thaxter, on *Haliplus ruficollis* De G., *Cnemidotus muticus* Lec., N. America.

GENUS XI. CHITONOMYCES. Receptacle asymmetrical, its distal portion united to the perithecium; its two basal cells superposed. Aquatic.

(1) **C. paradoxus** (Peyritsch), on *Laccophilus maculosus* Germ., *Laccophilus* sp. indet., N. America; *L. hyalinus* Dej., *L. minutus* Sturm., Europe.

(2) **C. appendiculatus** Thaxter, on *Laccophilus maculosus* Germ., N. America.

(3) **C. distortus** Thaxter, on *Laccophilus maculosus* Germ., N. America.

(4) **C. spinigerus** Thaxter, on *Laccophilus maculosus* Germ., N. America.

(5) **C. uncigerus** Thaxter, on *Laccophilus maculosus* Germ., N. America.

(6) **C. melanurus** Peyritsch, on *Laccophilus hyalinus* Dej., *L. minutus* Sturm, Europe.

(7) **C. marginatus** Thaxter, on *Laccophilus maculosus* Germ., *Laccophilus* sp. indet., *Hydroporus spurius* Lec., N. America.

(8) **C. rhyncostoma** Thaxter, on *Hydroporus spurius* Lec., *Laccophilus maculosus* Germ., N. America.

(9) **C. lichanophorus** Thaxter, on *Laccophilus maculosus* Germ., N. America.

(10) **C. uncinatus** Thaxter, on *Laccophilus maculosus* Germ., *Hydroporus spurius* Lec., N. America.

(11) **C. affinis** Thaxter, on *Laccophilus maculosus* Germ., *Hydroporus* sp., N. America.

(12) **C. hyalinus** Thaxter, on *Laccophilus maculosus* Germ., N. America.

(13) **C. simplex** Thaxter, on *Laccophilus maculosus* Germ., *Hydroporus spurius* Lec., and sp. indet., N. America.

(14) **C. Bidessarius** Thaxter, on *Bidessus granarius* Aube, N. America.

(15) **C. borealis** Thaxter, on *Desmopachria convexa* Aube, N. America.

(16) **C. aurantiacus** Thaxter, on *Desmopachria convexa* Aube, N. America.

ORDER II. Laboulbenieæ. Antheridial cells distinct, discharging independently.

A. Diœcious.

GENUS I. AMORPHOMYCES.

(1) **A. Falagriæ** Thaxter, on *Falagria dissecta* Er., N. America.

(2) **A. floridanus** Thaxter (species pro tem.) on *Bledius basalis* Lec., N. America.

B. Monœcious.

* Antheridia borne in definite series on the appendages.

x. Antheridia springing directly from successive cells of the appendage.

GENUS II. HELMINTHOPHANA. Appendage solitary, bearing the antheridia in four vertical series.

(1) **H. Nycteribiæ** Peyritsch, on *Megistopoda Westwoodii* Kolen., *Acrocholidia Montaguei* Kolen., and *Nycteribia Dufourii*, Europe.

GENUS III. STIGMATOMYCES. Appendage solitary, bearing the antheridia in a single vertical series.

(1) **S. entomophila** (Peck), on *Drosophila nigricornis* Loew., N. America, *Drosophila funebris* L., Europe.

(2) **S. Baeri** Peyritsch, on *Musca domestica* L., Europe.

(3) **S. virescens** Thaxter, on *Chilocorus bivulnerus* Muls., N. America.

GENUS IV. IDIOMYCES. Appendages numerous, bearing the antheridia in three vertical series.

(1) **I. Peyritschii** Thaxter, on *Deleaster dichrous* Grav., Europe.

xx. Antheridia borne on branches of the appendages.

GENUS V. CORETHROMYCES. Appendages forming a tuft, the antheridial cells superposed and forming lateral branchlets.

(1) **C. Cryptobii** Thaxter, on *Cryptobium pallipes* Grav., *C. bicolor* Grav., N. America.

(2) **C. setigerus** Thaxter, on *Lathrobium nitidulum* Lec., N. America.

(3) **C. jacobinus** Thaxter, on *Lathrobium jacobinum* Lec., and *L. collare* Er.

GENUS VI. RHADINOMYCES. Appendage single with terminal sterile branchlets; antheridia superposed in short series forming branchlets near its base.

(1) **R. cristatus** Thaxter, on *Lathrobium nitidulum* Lec., *L. punctulatum* Lec., N. America.

(2) **R. pallidus** Thaxter, on *Lathrobium fulvipenne* Grav., *L. punctulatum* Lec., *L. angulare* Lec., N. America.

** Antheridia not arranged in definite series on the appendages.

GENUS VII. RHIZOMYCES. Basal cell of the receptacle penetrating the host by rhizoidal outgrowths; sub-basal cell giving rise to a single simple appendage bearing unilaterally a single series of branches, the basal cells of which bear antheridia.

(1) **R. ctenophorus** Thaxter, on *Diopsis thoracica* Westw., Africa.

GENUS VIII. LABOULBENIA. Multicellular receptacle formed in part by the union of the base of the appendage and the stalk-cells of the perithecium. Appendages arising beside the perithecium usually from a black insertion cell.

(1) **L. anceps** Peyritsch, on *Platynus viduus* Pz., Europe.

(2) **L. arcuata** Thaxter, on *Harpalus pennsylvanicus* De G., N. America.

(3) **L. armillaris** Berlese, on *Antennophorus caput-carabis*, S. America.

(4) **L. Aspidoglossæ** Thaxter, on *Aspidoglossa subangulata* Chaud., N. America.
(5) **L. australiensis** Thaxter, on *Acrogenys hirsuta* Maclean, Australia.
(6) **L. Brachini** Thaxter, on *Brachinus mexicanus* Dej. and spp. indet., N. America.
(7) **L. brachiata** Thaxter, on *Patrobus longicornis* Say, *P. tenuis* Say, N. America.
(8) **L. Casnoniæ** Thaxter, on *Casnonia pennsylvanica* Linn., N. America.
(9) **L. Catascopi** Thaxter, on *Catascopus guatemalensis* Bates, N. America; *Catascopsus* two spp., Africa.
(10) **L. Clivinæ** Thaxter, on *Clivina dentifemorata* Putz., *C. dentipes* Dej., N. America.
(11) **L. compacta** Thaxter, on *Bembidium* spp. indet., N. America.
(12) **L. compressa** Thaxter, on *Anisodactylus baltimorensis* Say, N. America.
(13) **L. conferta** Thaxter, on *Harpalus pennsylvanicus* De G., N. America.
(14) **L. confusa** Thaxter, on *Bembidium* sp. indet., N. America.
(15) **L. contorta** Thaxter, on *Platynus extensicollis* Say, *P. affinis* Kirby, N. America.
(16) **L. cornuta** Thaxter, on *Bembidium complanulum* Mann., N. America.
(17) **L. Coptoderæ** Thaxter, on *Coptodera Championi*, Bates, N. America.
(18) **L. cristata** Thaxter, on *Pæderus littorarius* Grav., *P. obliteratus* Lec., *Pæderus* sp. indet., N. America; *P. ruficollis* Fabr., Europe.
(19) **L. curtipes** Thaxter, on *Bembidium bimaculatum* Kirby, N. America.
(20) **L. decipiens** Thaxter, on *Galerita nigra* Chev., *G. æquinoctialis* Chaud., N. America.
(21) **L. Diopsis** Thaxter, on *Diopsis thoracica* Westw., Africa.
(22) **L. elegans** Thaxter, on *Harpalus pennsylvanicus* De G., N. America.
(23) **L. elongata** Thaxter, on *Platynus cincticollis* Say, *P. extensicollis* Say, *P. melanarius* Dej., *P. ruficornis* Lec., *P. picticornis* Newm., *P. bicolor* Lec., *P. pusillus* Lec., *P. dissectus* Lec., *P. brunneomarginatus* Mann., *P. floridanus* Lec., *P. sinuatus* Dej., *P. ovipennis* Mann., *Anisodactylus baltimorensis* Say, *Colpodes purpuripennis* Chaud., *C. cœruleomarginatus* Chaud., *C. duplex* Bates, *C. grata* Bates, *C. petilis* Bates, *C. incultus* Bates, *C. sphodroides* Chaud., *C. cyanonotus* Chaud., *C. tenuicornis* Chaud., N. America. *Platynus ruficornis* Gœze, *Læmosthenes* (*Pristonychus*) *cavicola* Sch. Europe, *Platynus* sp., Asia (Japan), *Colpodes* sp., S. America, *Macrochilus biguttatus* Gœze, Africa.
(24) **L. europæa** Thaxter, on *Chlænius æneocephalus* Dej., *C. chrysocephalus* Rossi, *Callistus lunatus* Fabr., *Aptinus mutilatus* Fabr., *Brachinus explodens* Duft., Europe.
(25) **L. fasciculata** Peyritsch, on *Chlænius vestitus* F., *Omophron limbatum*, F., Europe.
(26) **L. filifera** Thaxter, on *Anisodactylus Harrisii* Lec., *A. nigerrimus* Dej., *A. interpunctatus* Kirby, *Anisodactylus* spp. indet., *Harpalus erythropus* Dej., *H. pleuriticus* Kirby, N. America.
(27) **L. flagellata** Peyritsch, on *Bembidium lunatum* Duft., Europe.
(28) **L. fumosa** Thaxter, on *Platynus cincticollis* Say, N. America.
(29) **L. Galeritæ** Thaxter, on *Galerita Janus* Fabr., *G. mexicana* Dej., *G. atripes* Lec., *Galerita* sp. indet., N. America.
(30) **L. gibberosa** Thaxter, on *Platynus extensicollis* Say, N. America.
(31) **L. Guerinii** Mont. et Robin, on *Gyretes sericeus* Lab., S. America; *G. compressus* Lec., N. America.

(32) **L. Gyrinidarum** Thaxter, on *Gyrinus fraternus* Coup., *G. affinis* Aub., *G. ventralis* Kirby, *G. analis* Say, *G. confinis* Lec., *G. consobrinus* Lec., *G. plicifer* Lec., *Gyrinus* spp. indet., N. America; *G. urinator* Illig., Europe.

(33) **L. Hageni** Thaxter, on *Termes mozambica* Hagen, Africa.

(34) **L. Harpali** Thaxter, on *Harpalus pennsylvanicus* De G., N. America.

(35) **L. inflata** Thaxter, on *Bradycellus rupestris* Say, N. America.

(36) **L. Kunkelii** Giard, on *Mormolyce phyllodes* Hagenb., Asia (Java).

(37) **L. lepida** Thaxter, on *Anisodactylus nigerrimus* Dej., N. America.

(38) **L. longicollis** Thaxter, on *Galerita leptodera* Chaud., *Galerita* sp. indet., Africa.

(39) **L. luxurians** Peyritsch, on *Bembidium* spp. indet., N. America, *Bembidium varium* Oliv., *B. bipunctatum* Duft., *B. flammulatum* Clairv., Europe.

(40) **L. macrotheca** Thaxter, on *Anisodactylus baltimorensis* Say, *Anisodactylus* sp. indet., N. America.

(41) **L. melanotheca** Thaxter, on *Galerita mexicana* Chaud., N. America.

(42) **L. mexicana** Thaxter, on *Galerita mexicana* Chaud., *G. nigra* Chev., *G. æquinoctialis* Chaud., N. America.

(43) **L. minima** Thaxter, on *Callida pallidipennis* Chaud., N. America.

(44) **L. Morionis** Thaxter, on *Morio Georgii* Pal., N. America.

(45) **L. Nebriæ** Peyritsch, on *Nebria pallipes* Say, *N. Sahlbergi* Fisch, *N. gregaria* Fisch, N. America; *N. brunnea* Duft., *N. villæ* Dej., Europe.

(46) **L. Oberthuri** Giard, on *Orectogyros heros* Reg., Madagascar.

(47) **L. Orectogyri** Thaxter, on *Orectogyros Bedeli* Reg., Africa.

(48) **L. Pachytelis** Thaxter, on *Pachyteles mexicanus* Chaud., N. America.

(49) **L. palmella** Thaxter, on *Mormolyce phyllodes* Hagenb., Asia (Java).

(50) **L. Panagæi** Thaxter, on *Panagæus crucigerus* Say, *P. fasciatus* Say, N. America.

(51) **L. parvula** Thaxter, on *Platynus extensicollis* Say, *P. æruginosus* Dej., *Platynus* spp. indet., N. America.

(52) **L. paupercula** Thaxter, on *Platynus melanarius* Dej., *P. ruficornis* Lec., *P. extensicollis* Say, N. America.

(53) **L. pedicillata** Thaxter, on *Bembidium* spp. indet., N. America.

(54) **L. perpendicularis** Thaxter, on *Bembidium* spp. indet., N. America.

(55) **L. Pheropsophi** Thaxter, on *Pheropsophus æquinoctialis* Linn., *Pheropsophus* spp. indet., S. America; *Pheropsophus marginatus* Dej. (?), *Pheropsophus* sp. indet., Africa.

(56) **L. Philonthi** Thaxter, on *Philonthus debilis* Grav., *P. cunctans* Horn, *P. micans* Grav., *P. æqualis* Horn, *P. furvus* Nord, *Philonthus* spp. indet., N. America.

(57) **L. polyphaga** Thaxter, on *Olisthopus parmatus* Say, *Stenolophus limbalis* Lec., *S. fuliginosus* Dej., *Badister maculatus* Lec., *Harpalus pleuriticus* Kirby, *Agonoderus pallipes* Fabr., *Loxandrus* several spp. (?), N. America; gen. indet., S. America (?); on *Amara* sp., Africa.

(58) **L. proliferans** Thaxter, on *Eudema tropicum* Hope, *Eudema* sp. indet., *Chlænius tenuicollis* Fabr., *C. velutinus* Duft., Africa; *Dolichus* sp. (?), Asia (Japan).

(59) **L. Pterostichi** Thaxter, on *Pterostichus adoxus* Say, *P. luctuosus* Dej., *P. mancus* Lec., *P. relictus* Newm., *Anisodactylus nigerrimus* Dej., N. America.

(60) **L. Quedii** Thaxter, on *Quedius vernix* Lec., N. America.

(61) **L. recta** Thaxter, on *Platynus extensicollis* Say, N. America.

(62) **L. rigida** Thaxter, on *Pterostichus patruelis* Dej., N. America.

(63) **L. Rougetii** Mont. et Robin, on *Brachinus crepitans* L., *B. explodens* Duft., *B. scolopeta* Fabr., Europe.

(64) **L. scelophila** Thaxter, on *Platynus extensicollis* Say, N. America.

(65) **L. Schizogenii** Thaxter, on *Schizogenius lineolatus* Say, *S. ferrugineus* Putz., *Clivina cordata* Putz., N. America.

(66) **L. subterranea** Thaxter, on *Anophthalmus Menetriesii* Motsch., *A. pusio* Horn, N. America; *A. Motschulskyi* Schm., Europe.

(67) **L. terminalis** Thaxter, on *Pterostichus luctuosus* Dej., N. America.

(68) **L. texana** Thaxter, on *Brachinus* spp. indet., N. America.

(69) **L. truncata** Thaxter, on *Bembidium* sp. indet., N. America.

(70) **L. umbonata** Thaxter, on *Stenolophus ochropezus* Say, N. America.

(71) **L. variabilis** Thaxter, on *Anomoglossus pusillus* Say, *Chlænius æstivus* Say, *C. cumatilis* Lec., *C. cursor* Chev., *C. leucoscelis* Chaud., *C. floridanus* Horn, *C. pennsylvanicus* Say, *C. ruficaudis* Chaud., *C. sparsus* Lec., *C. texanus* Horn, *C. tricolor* Dej., *C. viridicollis* Reiche, *Omophron americanum* Dej., *Omophron* spp. indet., *Patrobus longicornis* Say, *Platynus extensicollis* Say, *Pterostichus adoxus* Say, *P. luctuosus* Dej., *P. corvinus* Dej., *P. caudicalis* Say, *P. Sayi* Brullé, *Nebria pallipes* Say, *Blethisa multipunctata* Fabr., *B. quadricollis* Bald., N. America; *Pterostichus* (?) sp., S. America.

(72) **L. vulgaris** Peyritsch, on *Bembidium mexicanum* Dej., *B. lævigatum* Say, and many spp. indet., *Trechus chalybeus* Mann., N. America; *Bembidium littorale* Pz., *B. fasciolatum* Duft., *B. punctulatum* Drap., *B. lunatum* Duft., *B. obsoletum* Dej., *B. Andreæ* Sch., *B. flammulatum* Clairv., *B. decorum* Pz., *B. femoratum* Sturm., *B. bipunctatum* Duft., Europe; on gen. indet., Asia (?).

(73) **L. zanzibarina** Thaxter, on *Crepidogaster bimaculata* Boh., Africa.

GENUS IX. TERATOMYCES. Receptacle of three superposed cells above which a series of smaller cells arranged in a transverse series give rise to numerous appendages which completely surround the bases of the (one or more) perithecia.

(1) **T. mirificus** Thaxter, on *Acylophorus pronus* Er., N. America.

(2) **T. Quedianus** Thaxter, on *Quedius ferox* Lec., N. America.

(3) **T. brevicaulis** Thaxter, on *Actobius nanus* Horn, N. America.

(4) **T. Actobii** Thaxter, on *Actobius nanus* Horn, N. America.

GENUS X. DIPLOMYCES. Receptacle symmetrical with paired posterior projections, the appendages and perithecia also paired.

(1) **D. Actobianus** Thaxter, on *Actobius nanus* Horn, N. America.

GENUS XI. RHACHOMYCES. Receptacle consisting of a main axis of superposed cells from which on one side smaller appendiculate cells are separated, the perithecia sub-terminal.

(1) **R. speluncalis** Thaxter, on *Anophthalmus pusio* Horn, N. America.

(2) **R. lasiophorus** Thaxter, on *Atranus pubescens* Dej., *Badister micans* Lec., *Acupalpus carus* Lec., and gen indet., N. America.

(3) **R. arbusculus** Thaxter, on gen. indet., near Lathrobium, Africa.

(4) **R. longissimus** Thaxter, on *Colpodes evanescens* Bates, N. America.

(5) **R. furcatus** Thaxter, on *Othius fulvipennis* Fabr., Europe.

(6) **R. hypogæus** Thaxter, on *Anophthalmus Bilimeki* Sturm., Europe.

(7) **R. Lathrobii** Thaxter, on *Lathrobium longiusculum* Grav., *Lathrobium* sp. indet., N. America.

(8) **R. pilosellus** (Robin), on *Lathrobium fulvipenne* Grav., Europe.

GENUS XII. CHÆTOMYCES. Receptacle a simple series of superposed cells, the appendages and perithecium forming a single vertical series.

(1) **C. Pinophili** Thaxter, on *Pinophilus latipes* Er., N. America.

GENUS XIII. SPHALEROMYCES. Receptacle two-celled, the single simple appendage bearing a series of antheridial branchlets superposed in a single row.

(1) **S. Lathrobii** Thaxter, on *Lathrobium nitidulum* Lec., *L. punctulatum* Lec., N. America.

(2) **S. occidentalis** Thaxter, on *Pinophilus densus* Lec., N. America.

GENUS XIV. COMPSOMYCES. Receptacle two-celled, the upper cell bearing the appendages and stalked perithecium in a whorl. Perithecium with two stalk-cells, the lower appendiculate.

(1) **C. verticillatus** Thaxter, on *Sunius longiusculus* Mann., N. America.

GENUS XV. MOSCHOMYCES. Receptacle two-celled, several arising from a compacted cellular base intruded into the body cavity of the host. Perithecium borne on two stalk-cells, the lower appendiculate.

(1) **M. insignis** Thaxter, on *Sunius prolixus* Er., N. America.

GROUP II. Exogenæ. Antherozoids produced exogenously. Typically aquatic.

ORDER. Zodiomyceteæ.

GENUS I. CERATOMYCES. Appendage tapering with lateral branches, receptacle few-celled, wall-cells of perithecium seven or more in each row.

(1) **C. mirabilis** Thaxter, on *Tropisternus glaber* Hb., *T. nimbatus* Say, N. America.

(2) **C. confusus** Thaxter, on *Tropisternus glaber* Hb., *T. nimbatus* Say, N. America.

(3) **C. camptosporus** Thaxter, on *Tropisternus glaber* Hb., N. America.

(4) **C. minisculus** Thaxter, on *Tropisternus nimbatus* Say, N. America.

(5) **C. filiformis** Thaxter, on *Tropisternus glaber* Hb., *T. nimbatus* Say, N. America.

(6) **C. rostratus** Thaxter, on *Hydrocombus fimbriatus* Melsh., *Philhydrus cinctus* Say, *P. nebulosus* Say, N. America.

(7) **C. terrestris** Thaxter, on *Lathrobium punctulatum* Lec., N. America.

(8) **C. furcatus** Thaxter, on *Berosus striatus* Say, N. America.

(9) **C. contortus** Thaxter, on *Berosus striatus* Say, N. America.

(10) **C. humilis** Thaxter, on *Berosus striatus* Say, N. America.

GENUS II. ZODIOMYCES. Receptacle parenchymatously multicellular, the numerous perithecia surrounded by sterile appendages arising from its cup-shaped extremity.

(1) **Z. vorticellarius** Thaxter, on *Hydrocombus lacustris* Lec., *H. fimbriatus* Melsh., and sp. indet., N. America.

In addition to the forms above enumerated, which include one hundred and fifty-two species and twenty-eight genera, a certain number of undescribed forms are known, including several new genera. Of these, three species belong to the genus Laboulbenia, two of them North American, on Bledius and Anophthalmus, and one European, on Patrobus (Peyritsch); one to Cantharomyces, on Ancyrophorus; one to Chitonomyces, on an unknown host, together with a new genus, on Bledius, and a doubtful genus on Tachinus. The total number of forms known to exist, excluding certain doubtful species referred to by Peyritsch, is thus one hundred and fifty-eight.[1] Although this number may be assumed to illustrate the group in a general way, it is certain that many important additions are inevitable, and from the data available a rough estimate of the numbers of the family existent in all parts of the world would be from five hundred to one thousand.

The following descriptions, a majority of which first appeared in the "Proceedings" of the Academy, have been largely rewritten and revised with additional notes in the light of more abundant material and a more complete knowledge of the group. As will be observed, a limited number are here described for the first time, and include some of the most important additions to the family.

[1] To these must be added a new aquatic genus near Chitonomyces, which is alluded to under that genus, and two undescribed species of Ceratomyces.

Family LABOULBENIACEÆ Peyritsch.

DIMORPHOMYCES Thaxter. Plate V, figs. 1–16.

Proc. Am. Acad. Arts and Sci., Vol. XXVIII, p. 157.

Diœcious. *Male individual* consisting of four superposed cells, the two distal ones sterile, the sub-basal producing a compound antheridium, the six antheridial cells of which are arranged in two antero-posterior rows and discharge into a common cavity lying above them, from which the antherozoids escape through a prominent tubular neck.

Female individual consisting of four superposed cells, the two distal ones sterile, the sub-basal cell giving rise to two or more perithecia and sterile appendages which alternate with one another on either side, forming a transverse series. Trichogyne short, radiately branched. Spores once septate.

The material available for the illustration of this genus, although abundant, includes, unfortunately, no young individuals in which the first stages in the development of the primary perithecia are shown. Owing to the small size of the plant and the indistinctness of its septa, it has been difficult to determine with certainty the exact relation which the perithecia and sterile appendages bear to the receptacle. While in most cases the latter has seemed to consist of three superposed cells, as in fig. 1 or 5, in a few specimens I have thought that there was an indication of the presence of septa as is indicated in fig. 4. If the first of these alternatives proves to be correct, the portions of the receptacle which bear the appendages and perithecia must be considered as wing-like outgrowths from the basal cell; while in the second instance they would originate from a sub-basal cell. Although in no other genus, with the exception of Amorphomyces, is anything approaching a similar condition found, I am inclined to think that the first-mentioned alternative is the correct one.

In form and development the species of Dimorphomyces are very peculiar. There is a general triangular outline to the portion below the sterile cells of the receptacle, a tendency to a posterior convexity and anterior concavity; and in both species the first organs to be developed are a pair of primary perithecia symmetrically placed and followed immediately by a sterile appendage placed externally on either side. In many individuals there seems to be no further development (fig. 3); but very commonly two or four secondary perithecia are formed, alternating with as many sterile appendages. The process by which these organs are formed is unlike any corresponding process in other genera. Assuming that my observations are correct in deriving them from the sub-basal cell of the receptacle, the first step in their formation would consist in the production of two anterior projections from this cell symmetrically placed on either side of the median line. The tip of each projection is cut off, and the cell thus separated develops upward into a perithecium. Meanwhile a lateral proliferation takes place below this

septum, and from it arises a second projection, the upper portion of which is cut off as before, and develops into a primary appendage, external to each primary perithecium. This condition is represented in figs. 2 and 3. The same process may continue through the production of further successive lateral proliferations, new cells being separated as above described, and developing upward into new perithecia and sterile appendages. As a result of this process a fan-like habit is developed, a series of alternating perithecia and appendages extending obliquely upwards on either side from their common point of origin in the median line of the receptacle, their bases resting upon a unicellular margin (figs. 1 and 5), which results from its repeated proliferation. The alternation of perithecia with appendages appears to be invariable; except in abnormal cases, where, for example, a perithecium has failed to develop, as at the left in fig. 1.

The appendages themselves present no special peculiarities, and consist merely of a single series of superposed nearly cylindrical cells. The perithecium originates from a single cell that divides into a lower and upper portion, the former the primordial cell of the perithecium proper, the latter of the procarpe. The development of the former is made out with great difficulty, the septa being very indistinct. It is probable, however, that it corresponds in general with the course of development described as typical in the first part of this memoir; although in the mature perithecium all signs of septa have disappeared, and the cavity of the stalk-cell and of the perithecium are continuous (fig. 3), the single ascogenic cell with its ascus mass floating free within.

The spores are of the usual type, and are once-septate. As in the genus Amorphomyces, the members of any given spore pair produce one a male, the other a female individual; the two sexes being thus invariably associated, as in figs. 2 and 5.

The male individuals are very similar in the two known species, and are often indistinguishable. Owing to their minute size, I have been unable to obtain material of the youngest stages for figuring, the only early condition observed having been unfortunately lost in an attempt to mount it. In this specimen it was evident, as could be inferred from an examination of the mature individual, that the antheridium was developed as a lateral production from the sub-basal cell of the receptacle. The receptacle, as in the female, consists of four superposed cells, the two terminal ones sterile. The antheridium itself consists of a basal cell, above which are three small cells, of somewhat unequal size, from which the antheridial cells arise. The latter are arranged in three pairs; and all six cells discharge the antherozoids formed within them into a common cavity, that forms the slightly inflated base of the long tubular neck through which they are finally discharged. The formation and discharge of antherozoids continues for a considerable period, so that provision is made for the fertilization of as many secondary perithecia as may be formed upon the female individual; and the number of antherozoids eventually produced by a single individual must be very great.

The genus appears to bear no special relation to Amorphomyces, which, in all essential points of structure, with the exception of the remarkable similarity of its trichogyne, is widely different in both sexes. Yet it is singular that these, which are, with one exception, the only two diœcious genera so far discovered, should inhabit the same minute host.

Scientifically considered, the three diœcious genera, of which this may be taken as a type, may certainly claim a position first in importance among the Laboulbeniaceæ, if not among the Ascomycetes as a whole, since their morphology and development would seem to settle beyond

any reasonable doubt the vexed question as to the presence of sexuality in the higher fungi. The immediate relation of the present to other genera, with the exception of Dimeromyces, is not clear; yet it seems probable that among described forms the species of Dichomyces and Peyritschiella approach it more nearly than any others. In both of these instances the same tendency towards a bilateral development is combined with a close correspondence in the sexual organs.

DIMORPHOMYCES DENTICULATUS Thaxter. Plate V, figs. 11–16.

Proc. Am. Acad. Arts and Sci., Vol. XXVIII, p. 157.

Male individual. Receptacle of four superposed cells, the distal one tapering upward, and terminated by a more or less distinctly marked, usually slightly blackish, knob. Antheridium arising from the sub-basal cell and partly united to the sub-terminal cell of the receptacle; externally nearly straight, bulging internally; its main body about as long as the usually straight terminal neck, the base of which is distinctly inflated to form the cavity into which are discharged the antherozoids. Total length to tip of receptacle, 40μ; to tip of antheridium, 50–55μ. Greatest width, 14μ.

Female individual. Sterile portion of the receptacle consisting of a large sub-terminal and much smaller nearly spherical terminal cell, the main portion consisting of two superposed cells forming a more or less three-sided body, the perithecia and sterile appendages arising in the manner characteristic of the genus. Perithecia slightly inflated, rather abruptly contracted to form the stalk portion; the tip oblique; one of the lip-cells projecting as a short but distinct tooth-like prominence; while just below this prominence a conspicuous tooth-like outgrowth arises from one of the anterior sub-terminal wall-cells, and extends obliquely upward and outward more than half its length beyond the tip of the perithecium. The stalk of the perithecium is usually strongly curved, so that the latter is bent backward beyond the terminal portion of the receptacle. Sterile appendages simple, septate, tapering slightly, usually bent away from the perithecia. Spores 22–$25 \times 3\mu$. Perithecia 65–$70 \times 15\mu$. Appendages about 110μ. Receptacle about 40μ long.

On *Falagria dissecta* Er., Waverly, Mass., and Kittery Point, Maine.

Better and more abundant material of this species has made necessary important changes in the original diagnosis above cited. The species is a rare one, occurring on the abdomen of its host close to the edges of the last abdominal rings on the upper or under sides, and may be seen projecting beyond their margin in a position indicated in fig. 2. They occur always in pairs, comprising the two sexes; and numerous pairs are not infrequently found crowded together and producing a little tuft which may be seen without great difficulty under a hand lens. The anterior face is usually turned towards the substratum, and the divergence of the appendages and perithecia gives the plant a characteristic habit, indicated in fig. 11, and makes it almost impossible to obtain a view which is either wholly posterior or wholly anterior. The species seems a very constant one, varying but slightly in size, and usually producing only two perithecia. The host, Falagria, may be obtained in great abundance from almost any decaying vegetable matter in fields, and is most readily captured by shaking such material over a white cloth. It is the smallest host known to be infested by any of the Laboulbeniaceæ.

DIMORPHOMYCES MUTICUS Thaxter. Plate V, figs. 1–10.

Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 104.

Male individual, as in *D. denticulatus*, slightly larger, the basal and sub-basal cells often more or less suffused posteriorly with blackish brown.

Female individual, as in *D. denticulatus*, more rigid and flattened in habit, the perithecia and appendages not bent away from one another. The perithecium larger, longer, proportionately more slender, its apex truncate or but slightly oblique, the sub-terminal wall-cells producing no tooth-like outgrowth. Spores $23–26 \times 3\mu$. Perithecia $75–90 \times 15\mu$. Total length to tip of perithecium, $90–130\mu$.

On *Falagria dissecta* Er., Waverly, Mass., and Kittery Point, Maine.

This species occurs sometimes in company with the last on the same host. It is at once distinguished by its larger unarmed perithecia, which never show any indication of the prominence so characteristic of *D. denticulatus*. Its general habit, though it develops under identical conditions, is also quite different from that of the preceding species, and no tendency to an antero-posterior divergence is observable between the perithecia and appendages. The conformation of the tips of the perithecia in either case, as shown in figs. 7 and 13, is also very different. Four or even more perithecia are not rarely developed in this species, and in fig. 1 an instance is shown of an unusually highly developed individual in which the single primary perithecium that remains is bent to the left, its fellow having been broken off or destroyed, while five new secondary perithecia are developing on either side; the youngest, at the extreme right, consisting of a mere prominence not yet separated from the proliferating marginal cell described in the preceding account of the genus. The same figure shows the remarkable phenomenon of an almost complete development of two male spores within the old primary perithecium. The species is more abundant than the preceding and more readily seen, from the greater size of its projecting perithecia.

DIMEROMYCES nov. gen. Plate IV, figs. 12–17.

Diœcious. Male individual consisting of a series of superposed cells from which are produced, laterally, sterile appendages and antheridia in a single series. The antheridium compound, consisting of a stalk-cell followed by four basal cells, above which are six antheridial cells arranged symmetrically in the same plane, and discharging the antherozoids into a common cavity, whence they make their escape through a terminal orifice, at the tip of a long, slender, tubular, terminal prolongation.

Female individual like the male, the antheridia being replaced by perithecia. The latter stalked, the cavity of the stalk-cell, basal cells and perithecium proper, eventually continuous, through the absorption of all the septa.

This is in some respects among the most interesting of all the genera of Laboulbeniaceæ, since it combines with a diœcious habit a more complicated development of the male individual than is found in any other instance. In Dimorphomyces, to which it is more closely allied than to any other genus, the antheridium is nearly, if not quite, as highly developed; but it is always

solitary, and the receptacle is very greatly reduced, being quite different from that of the female; while in the present genus it differs only in its slightly smaller size. The antheridium is almost identical in structure with that of Dimorphomyces, from which it differs only in its more slender and elongate form, and in its free stalk-cell. The perithecium also, when mature, shows the same remarkable absorption of its basal septa which one finds in the last-mentioned genus, its whole cavity, from the apex to the insertion of the stalk-cell, becoming continuous about the time that the spores begin to mature. The trichogyne, as far as can be determined from a somewhat imperfect specimen (fig. 17), is small and irregularly inflated.

The receptacle is quite unique in structure, and apparently in development. The material available does not, unfortunately, illustrate the complete development, there being no very young stages; but it is evident that the young plant ends with a single primary appendage, which is the upper one of the series in the mature individual. Then, by successive divisions of the basal cell of the receptacle, new cells appear to be cut off from its distal end; each of which, in its turn, cuts off a small cell, always on the same side, from which the secondary appendages, the perithecia, and the antheridia are directly developed. A somewhat similar arrangement of organs is found in the female individual of Dimorphomyces; but in this case the series are twofold and the proliferations terminal from wing-like lateral outgrowths.

Dimeromyces africanus nov. sp. Plate IV, figs. 12–18.

Male individual brownish. Receptacle consisting of usually seven very obliquely superposed cells, from all of which, except the basal, may be developed on the side which is uppermost, a sterile appendage or an antheridium in no regular order except that the terminal cell always bears an appendage. Antheridia rarely more than three, usually two, somewhat flattened, borne on a short free stalk-cell, the basal cells small, the six antheridial cells in two transverse rows of three each, the neck long and slender, slightly curved, its base distinctly inflated. The appendages simple, rigid, septate, tapering, becoming blackish brown; the sub-basal cell somewhat constricted and deeply suffused with blackish brown. Antherozoids about $2.5 \times .75\mu$, rod-like. Antheridia, including stalk-cell, $60 \times 10\mu$, the neck, including its inflated base, about 38μ. Receptacle, $125–150 \times 35\mu$.

Female individual like the male, but larger; the receptacle usually consisting of eleven cells, the antheridia replaced by banana-shaped perithecia, one to four in number, short-stalked, brownish; the distal end more deeply suffused, and tapering somewhat abruptly to the broadly truncate apex. Spores once septate $75 \times 5.5\mu$. Perithecia, $140–175 \times 26–35\mu$, including stalk-cell. Appendages (longer), $175–260\mu$. Receptacle, $120–150 \times 35–50\mu$.

On *Pachyteles luteus* Hope, Mt. Coffee, Liberia (O. F. Cooke).

The types of this interesting form were found on two specimens of the host which were among the insects kindly loaned me for examination by Professor Cooke, and occurred on the inferior surface of the abdomen near the base of the two posterior pairs of legs. I was not able to determine from the material whether the sexes always grow in pairs, since from their position of growth it was not possible to remove a portion of the chitin bearing them without injuring the insect. It is altogether probable, however, that the development of the spore pairs corresponds to that of the other diœcious forms (Amorphomyces and Dimorphomyces).

HAPLOMYCES. Plate VII, figs. 1–10.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 159.

Receptacle consisting of two small superposed cells from which arise the single perithecium and the single antheridial appendage. Perithecium large, pointed, borne on a single stalk-cell surmounted by three basal cells. Antheridial appendage consisting of a basal cell surmounted by a terminal body, the antheridium, entirely divided by anastomosing septa into numerous small cells, and furnished with a short lateral projection, together with a sub-terminal short spine-like process arising from a rounded base. Asci four-spored, arising from eight ascogenic cells. Spores once septate.

Owing to the fact that no fresh material of this genus, or any of its younger stages have been examined, there are numerous points connected with it which need to be made clear. Unlike the succeeding genus, Cantharomyces, its nearest ally, the antheridium appears to be terminal, not lateral. No discharge of antherozoids was observed in any of the specimens examined, and it is uncertain how and where such discharge takes place. Certainly not through the terminal spine-like process, so characteristic in the genus, which is undoubtedly a peculiarly modified sterile cell, perhaps the remains of the original terminal spore segment. It seems more probable that a lateral projection prominent in some specimens (at the right in fig. 3) represents the point of discharge; but what relation the irregularly honeycomb-like mass of cells composing the body of the antheridium bears to this projection, or how many of these cells are really spermatic, it is impossible to say. Examined with an immersion, indications of a central cavity, containing small roundish bodies, probably antherozoids, and extending upward and outward to the external projection previously mentioned, may be made out, though not with sufficient definiteness to enable one to figure these structures. From analogy with related genera, however, there can be little doubt that some such arrangement of the spermatic cells about a common cavity must exist.

The perithecium is remarkable from the fact that it contains eight ascogenic cells arranged symmetrically in four pairs, a condition only occurring in this and, perhaps, in the succeeding genus.

The hosts of these curious little forms all belong to the staphylinid genus Bledius, common further south along the sandy or gravelly margins of streams, especially in shady places, where they may be found under stones or burrowing in the sand. The only material examined has been that contained in the collection of the Museum of Comparative Zoology at Cambridge.

Haplomyces californicus Thaxter. Plate V, figs. 1–4.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 159.

Perithecia olive brown, tapering abruptly to the small blunt apex, greatly inflated externally, internally nearly straight; a distinct prominence, the base of the old trichogyne, usually visible on its anterior face below the apex, its basal cells short, wider than long, more or less suffused with olive brown, the stalk-cell stout, sub-triangular, hyaline. Receptacle small; its basal cell nearly hyaline, more than twice as large as the sub-basal, which is intensely blackened

and quite opaque, as is the basal cell of the appendage, except along its inner margin. Antheridium twice as long as broad, slightly convex inwardly and concave outwardly; its thorn-like appendage sharp, prominent. Spores, 37–40 × 3 μ. Perithecia, 130–145 × 65 μ, the stalk-cell 45–50 × 38 μ. Receptacle, 45–55 × 15–18 μ. Antheridium, 33 × 19 μ. Total length of appendage, 48–55 μ. Total length to tip of perithecium, 240–260 μ.

On *Bledius ornatus* Lec., California.

This species was found growing on the abdomen of a single specimen of its host, examined in the collection of the Museum of Comparative Zoology. It seems to be sufficiently distinguished from the succeeding species by its olive brown color and very differently shaped perithecium. The fourteen type specimens show no variation from the form represented in the plate.

Haplomyces virginianus Thaxter. Plate V, figs. 7–10.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 160.

Perithecium short, stout, straw-yellow, outwardly inflated, the inner margin nearly straight, the distal portion conical, its apex bluntly pointed; stalk-cell long, nearly cylindrical, distally expanded slightly, the basal cells of perithecium very small, almost obsolete. Basal cell of receptacle large, the distal cell very small, and several times as broad as long, the stalk-cell of the perithecium arising from it, but also connected with the distal portion of the basal cell. Basal cell of antheridial appendage squarish, slightly broader than long, the antheridium rounded, its reticulations coarse, the thorn-like apiculus very fine (about 5 μ long) and abruptly distinguished from its flattened base. Spores, 33 × 3.7 μ. Perithecia, 110–130 × 55–60 μ. Stalk-cell of perithecium, 75–110 × 19–25 μ. Antheridium, 18 μ long, 22–23 μ wide. Receptacle, basal cell, 45–50 × 18–19 μ, distal cell about 18.5 × 6 μ. Total length to tip of perithecium, 220–275 μ. Total length of appendage, 30–33 μ.

On *Bledius emarginatus* Say, Virginia.

This curious little species was found growing on the abdomen of its host. It is very distinct from either of the remaining forms, and although approaching *H. californicus* more closely in the shape of its perithecium, is at once distinguished by the great elongation of the latter's stalk-cell, which is associated with a remarkable reduction in the size of its basal cells. The sub-basal cell of the receptacle is so reduced that the stalk-cell of the perithecium appears at first to arise from the basal cell. The antheridial appendage, though almost identical in the other two species, is here distinctly different in form and general appearance.

Haplomyces texanus Thaxter. Plate V, figs. 5–6*a*.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 160.

Perithecia almost symmetrically conical, straw-yellow, tapering to the rather blunt apex; the stalk-cell nearly hyaline, more than twice as long as broad, more slender at the base; the basal cells elongate, nearly equal. Receptacle small, the basal cell nearly hyaline; the distal cell very small, slightly broader than long, sometimes blackened and opaque, the opacity including the lower outer portion of the basal cell of the appendage, the unblackened portion of which,

together with the antheridium, becomes suffused with brown. Spores, 40–45 × 3.7 μ. Perithecia, 165–185 × 50–55 μ. Stalk-cell of perithecium, 65–90 × 26–33 μ. Antheridium, 32 × 18 μ. Receptacle, 37–45 × 18 μ. Total length to tip of perithecium, 315–370 μ. Total length of antheridial appendage 35–40 μ.

On *Bledius rubiginosus* Er., Texas.

Distinguished from the preceding species by its pale yellowish color, conical, nearly straight perithecium, and by the elongated basal cells of the latter.

The two varieties of this form represented in figs. 5 and 6 occurred together on the abdomen of the same individual; and though the blackened form may be taken as the type, it is improbable that the two are distinct, since similar variations in color are common in other cases.

CANTHAROMYCES Thaxter. Plate V, figs. 11–24.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 9; l.c. Vol. XXVIII, p. 161.

Receptacle consisting of two superposed cells, the distal producing one or more stalked perithecia, and one or more antheridial appendages. Perithecia sub-conical, borne on a single stalk-cell surmounted by three basal cells. Antheridial appendages consisting of two superposed cells, terminated by one or two cells which may bear several branches, the sub-basal cell divided into two parts longitudinally or obliquely, one of which (the antheridium) is subdivided by anastomosing septa into numerous small cells. Spores once septate. Trichogyne filamentous.

This genus is very closely allied to the preceding, differing only in the fact that the antheridium is not terminal, but lateral, on an appendage terminated by sterile branches and destitute of the spine-like process characteristic of Haplomyces. The general relations of its parts are otherwise similar, and its antheridium possesses the same characteristic irregularly honeycombed structure. In *C. Bledii*, the only species abundant material of which has been examined, two or even three perithecia may arise from the same receptacle, and very rarely two appendages. In the absence of fresh material, except in the case of the very minute *C. pusillus*, the exact nature and relations of the spermatic cells remains a matter of doubt. In one specimen of *C. Bledii*, a well-developed trichogyne is present, rather copiously branched and bearing no resemblance to the greatly reduced type characteristic of Peyritschiella and its allies. As in Haplomyces, there appear to be eight ascogenic cells, but this point has not been definitely determined. The species all occur on beetles belonging to the Staphylinidiæ.

Cantharomyces Bledii Thaxter. Plate VII, figs. 17–24.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 10.

Color pale yellowish. Perithecia sub-conical, nearly symmetrical, basally inflated, borne on a well-developed stalk-cell surmounted by three smaller basal cells, one to three arising from the sub-basal cell of the receptacle. Receptacle consisting of a basal and somewhat larger sub-basal cell; often deeply and broadly blackened externally and inferiorly, in which case it projects laterally. Appendage usually single, rarely two arising from the same receptacle;

consisting of a squarish basal cell followed by a somewhat larger sub-basal cell, almost the whole of which becomes divided into numerous small cells to form the antheridium proper, which is bordered internally by a narrow sterile cell above which the appendage becomes repeatedly and variously branched; the branches seldom extending beyond the middle of the perithecium. Spores, 25 × 3.5 μ. Perithecia, 90–130 × 33–55 μ, average, 114 × 42 μ. Total length of appendage, 90–180 μ, average, 150 μ. Total length to tip of perithecia, 200–370 μ, average, 280 μ.

On *Bledius assimilis*, Champaign, Ill.

I am indebted to the courtesy of Prof. S. A. Forbes for abundant material of this species, kindly sent me from the locality mentioned. A single undetermined species of Bledius, from northern Illinois in the Museum of Comparative Zoology, was also found infested by the same parasite; but no fresh material has been available for examination. The species varies very considerably in size; and forms in which the sub-basal cell is blackened might be mistaken for a distinct species, owing to the slight distortion which accompanies the discoloration. It occurs on all parts of the host, even the legs and antennæ. A species bearing some resemblance to the present form was also found on a species of Ancyrophorus from Lake Superior; but the two specimens examined are not sufficiently perfect to warrant their description.

CANTHAROMYCES OCCIDENTALIS Thaxter. Plate VII, figs. 15–16.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 161.

More or less suffused with brown. Perithecium rather short, sub-conical, slightly inflated toward the base; the distal portion very slightly curved outward, the apex bluntly pointed; stalk-cell large, cylindrical, not exceeding the antheridium; basal cells each several times as long as broad. Basal cell of receptacle very small, the sub-basal cell much larger, inflated without blackening, or externally and inferiorly deeply blackened and slightly incurved. Basal cell of the appendage similar to the distal cell of the receptacle, larger and unmodified, or similarly blackened; the sub-basal cell large, its upper inner portion obliquely cut off and divided into numerous small cells to form the antheridium, which bulges slightly on the inner side; the appendage terminated by several superposed cells. Perithecium, 96–100 × 60 μ. Stalk-cell of perithecium, 120–140 × 26 μ. Length of appendage to tip of antheridium, 110–150 μ. Total length to tip of perithecium, 280–335 μ.

On *Bledius armatus* Er., Utah.

Distinguished from *C. Bledii* by its brown color, the greater elongation of the basal cells of the perithecium, and the relatively small antheridium, which in *C. Bledii* is external and comprises five-sixths to three-quarters of the sub-basal cell. The two specimens examined have each a single perithecium, and but one appendage, the tip of which is somewhat broken. A number of young specimens apparently belonging to this species, and occurring on *B. jacobinus* Lec., have the terminal portion of the appendage unbranched and consisting of a short tapering series of superposed cells.

The figures given represent the two type specimens which were found on the abdomen of the host.

CANTHAROMYCES PUSILLUS Thaxter. Plate VII, figs. 11–14.

Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 100.

Perithecium becoming reddish brown, inflated just above the base, the distal portion conical, tapering to a blunt symmetrical apex, borne on a rather short narrow stalk-cell bent towards the appendage and separated from the perithecium by three small sub-triangular basal cells. Receptacle consisting of a very small basal and a much larger rounded sub-basal cell, more or less suffused with brown, which gives rise to the stalk-cell of the perithecium and the appendage. Antheridial appendage consisting of a large squarish basal cell followed by the antheridium proper, which is primarily a large squarish cell, its outer half, or more, becoming divided by anastomosing septa into numerous small cells, the inner portion also showing a division into two or three larger cells; the whole bearing terminally a series of usually three superposed flattened cells, strongly constricted at the septa, and giving rise distally to from one to three simple cylindrical, nearly hyaline, sparingly septate branches, usually exceeding the perithecium in length. Spores, $18 \times 2\,\mu$. Perithecia, $22–26 \times 30–55\,\mu$. Total length to tip of perithecia, $80–85\,\mu$, to tip of appendages, $90–120\,\mu$.

On *Trogophlœus* sp. York, Maine; Waverly, Mass.

This species is perhaps the smallest of the known forms of Laboulbeniaceæ, and is somewhat difficult to discover and remove from the legs or elytra of its host, where, however, it is not rarely found. Owing to its minute size, the detailed structure of the antheridium was not plainly made out, neither was any discharge of antherozoids noticed. Its structure corresponds so closely, however, to that characteristic of the genus as emended, that there can be little doubt of the correctness of its generic reference. It occurs more commonly on the legs or near the tips of the elytra of its host, a small blackish staphylinid common on wet logs along the margins of brooks or in wet rubbish caught in similar situations.

EUCANTHAROMYCES, Thaxter. Plate V, figs. 25–27.

Receptacle consisting of two superposed cells, giving rise on one side to a free stalked perithecium, on the other to a free appendage. The appendage consisting of a basal and sub-basal cell terminated by a compound antheridium. The antheridium formed from numerous small cells, obliquely superposed in three rows, bordered externally by a sterile cell, and terminated by a cavity from which the antherozoids are discharged through a short, irregular, finger-like projection.

This genus is based upon the peculiar structure of its antheridium, which appears to be distinctly different from the honey-comb-like body which occurs in Haplomyces and Cantharomyces, as well as from the more simple form illustrated by Camptomyces, which is, probably, its nearest ally. The material examined consists of but two type specimens, in one of which the antheridium was in perfect condition, the terminal cavity being filled with antherozoids. It is impossible to determine in this specimen whether all or only a few of the small cells which compose the antheridium are antheridial cells; but, from analogy with Dimorphomyces and Peyritschiella, it seems probable that the majority of them are; and that the cells represented in

the figure (Plate VII, fig. 27) merely represent the bases of such antheridial cells; the terminal portions extending upward and inward, and discharging into the common cavity. This matter cannot, however, be determined without an examination of fresh material of immature specimens.

Eucantharomyces Atrani Thaxter. Plate V, figs. 25–27.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 480.

Pale straw-colored. Perithecium rather long, slightly inflated, tapering to a blunt apex with rounded lips, its stalk consisting of a single large free basal cell surmounted by three smaller cells. Basal and sub-basal cells of the receptacle long and very obliquely superposed, lying almost side by side. The appendage consisting of a basal cell not wholly free, but partially connected with the stalk-cell of the perithecium at its base, followed by a second sub-triangular cell, the oblique upper walls of which separate it on the inside from the body of the antheridium proper, and on the outside from the narrow cell which forms the sterile margin of the latter. Antheridium sub-cylindrical with rounded apex, consisting of three series of obliquely superposed cells, decreasing in size from below upward, and running obliquely upward and outward, the lower series of six cells, the middle of four, and the upper of two; the three series terminating in a common cavity filled with antherozoids, which are discharged through a terminal irregular, finger-like projection, which is bent strongly outward. Perithecium, $135 \times 35\ \mu$. Length to tip of perithecium, $260\ \mu$. To tip of antheridium, $150\ \mu$.

On *Atranus pubescens* Dej., Virginia.

Two specimens of this form were found in company with *Rhachomyces lasiophorus*, on an example of Atranus kindly sent me by Mr. Pergande, and, although carefully sought for on all the available material of its rather rare host, has not been again observed. Neither of the specimens, which are both figured in the plate, are fully mature, and there is doubtless some slight further development of the perithecium. It is unlikely, however, that any difficulty will be encountered in its subsequent identification.

CAMPTOMYCES Thaxter. Plate VI, figs. 1–6.

Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 100.

Receptacle consisting of two superposed cells, the upper bearing the short-stalked perithecium laterally and the antheridial appendage terminally. Perithecium narrow, with coarse-lipped asymmetrical apex. Appendage consisting of a single large basal cell bearing the antheridium terminally. Antheridium multicellular, sub-conical, with a prominent terminal pore for the discharge of the numerous roundish antherozoids. Trichogyne developed as a small vesicular prominence from a permanent ear-like appendage which arises laterally from the young perithecium. Ascogenic cells two in number. Spores once septate.

It is much to be regretted that in this genus, as in all the genera closely allied to it in which the antheridium appears to be a terminal organ, no material is available which illustrates the first steps in its production. In the youngest conditions examined, the antheridium has, in all instances, attained nearly complete development, even when the perithecium is a mere bud from

the sub-basal cell of the receptacle. Whether the antheridium as a whole is truly terminal, and developed from the smaller of the two primary spore segments, is uncertain. When mature, it is a somewhat complicated organ; but in a general way corresponds to that of Dimorphomyces, except in the number and arrangement of its antheridial cells. The latter appear to be placed in probably two, possibly three, vertical rows, each cell extending obliquely inward and upward towards a general lateral and partly central cavity into which they discharge, and which is usually well filled with irregularly squarish or roundish antherozoids. I have been unable to make out to my own satisfaction whether all the smaller cells of the antheridium are spermatic, and what their exact disposition is. The figures given (5 and 6) represent only in a general way the relations of the cells to the cavity for the reception of antherozoids; the view in the one case being sectional in a plane which does not show the openings through which the antheridial cells discharge their contents; in the other (fig. 6), showing the appearances visible on the anterior (inner) *surface* of the organ. The antherozoids are produced in very large numbers, and no form that I have seen is so well adapted to illustrate their discharge, which almost invariably occurs when the specimen is placed in water. This is perhaps connected with the fact that the trichogyne is very rudimentary, consisting of a small vesicular prominence, with one or two short projections, and is not in close proximity to the antheridium, so that the production of a large number of male bodies is necessary to insure fertilization. The carpogenic cell is very large, and the trichophoric cell bears the trichogyne laterally and anteriorly, the latter subtended by a peculiar and well-marked prominence. This prominence, at the left in fig. 4, constitutes the basal portion of the trichogyne, the receptive portion of which is seen in the angle between it and the projecting apex of the trichophoric cell. The latter is separated from the base of the trichogyne by a septum which was accidentally omitted from the figure. The cavity of this basal portion, which becomes indurated and persists as a slight projection on the mature perithecium (fig. 2), is *not*, as represented, continuous with that of the trichophoric cell. The ascogenic cells are two in number, and the asci do not seem strictly biseriate.

Camptomyces melanopus Thaxter. Plate VI, figs. 1–6.

Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 101.

Perithecium tinged with brownish, slightly inflated towards the base, its distal half narrow, tapering gradually to the rounded attenuated apex, below which on one side is a rounded projection; borne on a large sub-triangular stalk-cell, surmounted by three smaller basal cells. Receptacle narrowly funnel-shaped, tapering to a pointed base, and consisting of a large basal cell, slightly translucent near its lower extremity, but otherwise becoming wholly opaque, followed by a flattened sub-basal cell, from which the mature perithecium with its stalk project nearly at right angles to the long axis of the receptacle, while distally it bears the appendage. Appendage consisting of a single squarish cell, followed by a flattened cell which bears terminally the sub-conical, slightly asymmetrical antheridium. Spores about $30 \times 3.5\,\mu$. Perithecium, $130–150 \times 30–33\,\mu$. Total length to tip of antheridium, $110–125\,\mu$. Greatest width, $25\,\mu$. Antheridium, $25 \times 16\,\mu$.

On *Sunius prolixus* Er., Waverly, Mass., and York, Maine. On *S. longiusculus* Mann., Kittery Point, Maine.

This curious species occurs rather rarely, more often on the upper than on the inferior surface of the abdomen of the two hosts mentioned, the receptacle lying close against the surface, while the perithecia project outward, often backward. Specimens on *S. longiusculus* are somewhat smaller and much paler than those on the larger host, the basal cell of the receptacle being more or less translucent. The form is not easily overlooked when mature, occurring usually in groups of half-a-dozen or more. The hosts may be found in dry hay or other rubbish in cultivated land.

ENARTHROMYCES nov. gen. Plates III–IV.

Receptacle consisting of a simple series of superposed cells, the distal ones bearing sterile appendages, those below giving rise to antheridia or perithecia or remaining sterile. Antheridia compound, terminally pointed and perforate, the six antheridial cells converging upward to a general cavity, into which they empty through narrow necks. Trichogyne simple, two-celled. Perithecia stalked, one or more formed by direct budding from the cells of the receptacle.

In the form and structure of its antheridium, and to some extent of its perithecium, this remarkable genus recalls Peyritschiella, to which it is undoubtedly more closely related than to any other. The series of specimens which constitute the types of the single species contain no very young individuals; yet it is apparent that, after the axis is formed and most of the sterile appendages have been produced, an antheridium arises, first originating as a lateral bud, in such a position that the first trichogyne when mature lies beside its apex. The antheridium is the largest thus far observed, of the compound type, and its general structure may be made out with no great difficulty. The antheridial cells are irregularly flask-shaped, and occupy the somewhat inflated basal portion of the organ, the distal part being more or less conical, and apparently originating from a single cell, the remains of a septum being usually visible (Plate III, fig. 19) just above the openings of the canals through which the contents of the antheridial cells are discharged. The cavity which it contains is of considerable size, and is often filled with free antherozoids. The latter are larger than other known forms of endogenous origin, and seem to be surrounded by a thin wall at the time of their final discharge. The trichogyne is quite peculiar, and invariable in form, being rather short and inflated, septate near the middle, and prolonged into a short terminal projection (Plate III, fig. 17, *t r*), which seems to be the only portion that is receptive, the remainder being distinctly thick walled. Indeed, it is only the terminal part of this projection that is very thin walled; so that, after fertilization, when this receptive portion has withered, the trichogyne appears to end in a short, cylindrical, and distally truncate and perforate outgrowth (fig. 18, *t r*). The young perithecia arise as lateral buds from the cells of the axis, becoming cut off from it in the form of free clavate cells (fig. 13), which become once septate (fig. 14) and follow the course of development described in Part I (p. 228).

ENARTHROMYCES INDICUS nov. sp. Plate III, figs. 13–19; Plate IV, figs. 8–11.

Pale amber or straw colored. Perithecia large, sub-cylindrical, terminally rather abruptly and symmetrically rounded below the short, clearly distinguished, broadly truncate apex, the lip-

cells of which end in papillate enlargements, while one of them produces posteriorly a clavate outgrowth bent abruptly upward near its base and extending free above the apex. Below the base of this projection, and on the same side, the perithecium is prominently hunched. Basal cells of the perithecium often rounded and bulging. Receptacle consisting of from fifteen to twenty superposed cells, somewhat longer than broad, the two lowest always sterile, the third always producing a perithecium, the sixth, more commonly the seventh, producing an antheridium; the cells immediately above the third producing perithecia or remaining sterile; those immediately above the sixth or seventh producing perithecia or antheridia or remaining sterile, the total number of antheridia rarely exceeding three; the perithecia rarely produced two from a single cell. The terminal cells of the receptacle, usually five or six in number, bearing septate, simple, lateral, sterile appendages. The latter straight, usually two borne on opposite sides of a given cell, but sometimes three or four from the same cell, deeply blackened and somewhat constricted in the region of their basal septum, consisting more commonly of seven cells, the fourth and sixth, and notably the fifth, broader and shorter than the others, the terminal cell longer than the rest and tapering to a blunt tip. Similar appendages rarely produced even below the uppermost perithecium. Spores, very long and slender, 120–130 × 5 μ. Perithecia, 140–160 × 50–60 μ; the outgrowth, 35 × 10 μ; the stalk-cell, 50–85 × 25–30 μ. Receptacle, 400–680 × 25–35 μ; average, 500 × 28 μ. Appendages, 140–200 × 20 μ.

On *Pheropsophus* sp., Booloo Valley, banks of the Beeas River, Northwest India.

Sufficiently abundant material of this fine species was obtained from the inferior surface of the thorax and abdomen of an undetermined Pheropsophus from the above-mentioned locality in the collection of the Museum of Comparative Zoology. Although varying somewhat in the number of perithecia developed, it seems to be an unusually constant form. Even the sterile appendages, although they vary in number in different individuals, are remarkably uniform, and rarely vary in respect to the number of cells which compose them. In many cases the first, and sometimes others of the perithecia become aborted, as a result of the non-fertilization of their trichogynes; and there may be three or even more such undeveloped perithecia on the same individual, with from one to three or even four which have reached maturity (Plate IV, fig. 8), so that although there are more commonly not more than two perithecia in a given individual, there may be six to eight, developed and undeveloped, in exceptional cases. In their color, habit, and peculiarly blackened bases, the sterile appendages, curiously enough, recall those of the Laboulbenia (*L. Pheropsophi*), which infests a similar host in Africa and South America; so much so that a young specimen, which was the first examined, was for the moment mistaken for an abnormal condition of this species. Owing to the large size of the sexual organs, this form offers unusually good opportunities for a closer study of the sexual processes, and it is to be regretted that it should occur in so remote a locality.

It seems doubtful whether the lower half of the two-celled body described as the trichogyne is not morphologically a portion of the trichophoric cell, since, though it is separated from the latter by a constriction, no septum is visible between them. In one instance, a second trichogyne was seen developed from the base of this basal half, the first trichogyne having failed to become fertilized.

PEYRITSCHIELLA Thaxter. Plate VI, figs. 7–24; Plate II, fig. 12.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 8, 1890.

Receptacle composed of four superposed areas: a basal consisting of a single cell; a sub-basal consisting of a single cell or of several cells transversely and asymmetrically disposed in a single row, one or more of which may be appendiculate; a sub-terminal area consisting of a similar series of several cells appendiculate at either side, and, on one side only, producing the single antheridium; and, lastly, a terminal series like the sub-terminal, but bearing one, rarely two, perithecia centrally placed; the cells of the series external to the perithecia, and the cell between them, if there are two, appendiculate. Antheridium conical, compound, forming a sharp, tooth-like projection on one side. Appendages simple, continuous, separated from the cell which bears them by a prominently constricted, usually blackened septum. Spores once septate. Perithecia symmetrical or nearly so, the tips ending in four papillæ.

This, together with the following and very nearly related genus Dichomyces, constitutes a peculiarly well marked type among the Laboulbeniaceæ, and no other form possessing a compound antheridium, with the exception of Dimorphomyces, presents the same tendency towards the production of a bilaterally symmetrical receptacle, which is so perfectly developed in Dichomyces. In the present genus, there is always an irregularity in the form, and an asymmetry in the disposition of the cells, especially in the two lower transverse series; and though in *P. geminata* a greater degree of symmetry is attained than in any other species, the lower series is always asymmetrical, and in all cases only a single antheridium is ever found.

The development of the receptacle is comparatively simple. The germinating spore, as in fig. 11, develops a terminal appendage which corresponds to the appendage lying at the left of the perithecium in figs. 8 and 10, or between the two perithecia in fig. 7. The larger, lower segment of the spore then divides into four cells, by the formation of three septa (fig. 12). The lower of these, the basal cell of the receptacle, undergoes no further modification, and in the single species *P. curvata*, the sub-basal cell remains unchanged. In all the other species, however, the sub-basal cell and the two cells above it become divided in a characteristic fashion. This division is effected by the formation of oblique septa cutting off the two upper angles of the cell, as in fig. 13. The small triangular cells thus formed begin to grow obliquely outward and upward, as seen at the right in fig. 13, and through the formation of further oblique divisions in these cells the characteristic transverse series result (fig. 14). The number and position of the appendages varies in different species and in different individuals, as indicated by the figures, and are quite peculiar in structure and appearance. They are simple and continuous, or sometimes pseudoseptate, and always connected with the cell that bears them by a characteristically constricted, usually blackened septum. They vary in shape from a mere bladder-like oval cell (fig. 20, Plate VI) to a more highly developed form, such as occurs in *P. curvata* (fig. 9). The appendages of the following genus, Dichomyces, are similar in all respects; but in no other case, with the exception of the species of Chitonomyces and its nearest allies do appendages occur having a similar appearance.

A single antheridium only is produced on one side from the sub-terminal member of the superposed cell-series. Their structure corresponds very closely to that of Dimorphomyces, ex-

cept that there appear to be not more than four antheridial cells (Plate II, fig. 12), which discharge into a common cavity above. The latter forms the slightly inflated base of the terminal conical portion of the organ, the antherozoids, which are comparatively minute, making their way through a pore at its apex.

The perithecia, except in *P. geminata*, are usually solitary, and arise normally from the distal cell-series; but in abnormal cases they may be produced externally from the sub-distal or even the lower series (*P. geminata*). In structure, the perithecia present no great peculiarities; the cell-rows containing each four cells, the lip-cells being usually characteristically papillate, and symmetrical or nearly so. The ascogenic cell is commonly solitary (Plate I, figs. 27–31); but in some instances there appear to be two. The trichogyne, in the few cases in which it has been observed, is very rudimentary, consisting of a vesicular prominence, sometimes showing a tendency to produce slight protuberances, as in the case of Camptomyces.

The four known species all occur on terrestrial beetles belonging to the Carabidæ and Staphylinidæ, and on account of their small size and appressed habit are usually detected with difficulty.

In the following descriptions the side which bears the antheridia is spoken of as the anterior, the opposite as the posterior face of the individual. The antheridium may thus be described as occurring on the left side.

Peyritschiella curvata Thaxter. Plate II, fig. 12; Plate IV, figs. 11–18.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 8.

Perithecia hyaline, nearly straight, tapering to the symmetrically four-lobed apex, bent at an angle to the axis of the receptacle, the curvature of which it continues. Receptacle consisting of two superposed cells, followed by two transverse series of cells of variable numbers (four to seven); the terminal bearing one, rarely two, perithecia, with a group of sterile appendages on either side, the sub-terminal producing on one side, the sharply pointed antheridium with or without one or more adjacent sterile appendages; on the other side a group of from one to three similar appendages. Appendages simple, cylindrical, continuous, or pseudoseptate, hyaline, sometimes becoming tinged with brownish. Spores, $26 \times 3.5\text{–}4\,\mu$. Perithecia, $90\text{–}100 \times 22\text{–}29\,\mu$. Appendages (longer), $60\,\mu$. Total length to tip of perithecium, $280\text{–}300\,\mu$.

On *Platynus cincticollis* Say. Vicinity of New Haven, Conn., of Cambridge, Mass., and of Kittery Point, Maine.

The more common species of the genus occurring on the right shoulder of its host, and sometimes on the adjacent edge of the elytra. It is distinguished from the three remaining species by the absence of the lower transverse series of cells, the sub-basal cell of its receptacle remaining undivided at maturity. In very rare instances, two perithecia may be borne on a single individual; but I have seen but two cases of this kind among some dozens of specimens. The curved habit of the species is doubtless due to its position of growth upon the host, and is a character of little importance. The beetle on which it is found is common in the localities mentioned, along small brooks, where it may be found, concealed beneath stones, sticks, and rubbish generally, in shady places.

Peyritschiella geminata Thaxter. Plate IV, figs. 7–8 and 24.

Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 101.

Hyaline. Receptacle asymmetrical, consisting of a single basal cell followed by three successive, more or less definite, transverse rows of cells. The lowest of these rows is the most variable and irregular, consisting of from two to four cells, one of which, larger than the rest, is an axile cell continuing the basal cell directly, while the remaining one to three cells are cut off from it on one side, each successive cell smaller and placed higher in the series, the outermost and uppermost bearing one of the sterile appendages characteristic of the genus. The second row also consists of a larger median cell, which is free for a short distance on one side, and on both sides of which are cut off, as in the first row, from two to four cells, the smaller uppermost ones on both sides giving rise to from one to three appendages, according to the number of the cells. The upper row is either symmetrical or asymmetrical, according as it gives rise to two or to only one perithecium. In the first instance it consists of a median cell, above which are produced two sterile appendages, and a variable number of cells cut off laterally as in the lower rows, but nearly symmetrical in size and shape, the outermost bearing sterile appendages. If one perithecium only is produced, the row is asymmetrical, and a greater number of appendages appear on one side of the perithecium than on the other. Perithecia very slightly inflated near the base, tapering abruptly but slightly to the spreading apex, which is four-lobed, the lobes rounded, large and prominent. Spores about $37 \times 3.7\,\mu$. Perithecia, $75–80 \times 18–22\,\mu$. Total length to tip of perithecia, $220–260\,\mu$ ($150\,\mu$ in specimens from the smaller host).

On *Pterostichus luctuosus* Dej., *P. erythropus* Dej., and *P. patruelis* Dej., Kittery Point, Maine; Arlington, Mass.

Unlike the other species, this form not infrequently produces two perithecia, the arrangement of its distal cells in such cases closely resembling that of Dichomyces. The main body of the receptacle is, however, asymmetrical, and the antheridium occurs only on one side.

It is distinguished from the preceding species by its more slender form, smaller and shorter appendages and perithecia, and especially by the division of the sub-basal cell of its receptacle to form an incomplete transverse series, or rather half-series, of cells. Its antheridium is small and inconspicuous, occurring on one side as in the other species. It may be found growing on the inferior surface of the prothorax near its anterior margin, and on the adjacent posterior margin of the prothorax, as well as on the anterior legs. In the last position the individuals become very considerably distorted in form, and in such specimens several instances have been observed in which perithecia were developed from the lower and middle transverse series of cells on the right side (opposite the antheridium).

The species is a rare one, though the hosts which it infests are not uncommon under stones or in rubbish near the margins of ponds or streams.

Peyritschiella minima Thaxter. Plate VI, figs. 19–21.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 266.

Hyaline or slightly yellowish. Perithecia somewhat asymmetrical, large, stout, tapering rather abruptly to the blunt apex, which terminates in four not very prominent, nearly symmetri-

cal papillæ. Receptacle stout, sub-triangular in form, consisting of a rather small, often slender, basal cell, followed by the usual three transverse series of cells. The lower of these consists of the median or primary cell, on one side of which a single small cell is cut off, while on the opposite side a series of four or more cells, mostly appendiculate, extend obliquely upward and outward, overlapping one another to some extent. The middle series consists of a large median cell, on either side of which numerous (four or more) appendiculate cells extend obliquely upward and outward, and produce, on one side, the large pointed antheridium, which does not usually project beyond the margin of the receptacle. The distal series, like the sub-distal, composed of fewer cells and bearing the single perithecium. Appendages oval or short cylindrical, becoming brownish; their basal septa large, but not conspicuously blackened. Spores, 37–40 × 4 μ. Perithecia, 100 × 33 μ. Appendages (longest), 33 μ. Total length to tip of perithecium, 190–220 μ. Receptacle, 90–110 × 50–58 μ.

On *Platynus cincticollis* Say. Vicinity of New Haven, Conn.; Weston, Mass.; York, Maine.

A rare species occurring near the extremity of the anterior legs of its host, where, owing to its compact form and small size, it is easily overlooked. It is very distinct from the two preceding species, and peculiar from its sub-triangular form, from the presence of cells cut off on *both* sides of the primary or median cell of the lower transverse series, and from the numerous short, inflated, bladder-like appendages. The latter are thickly clustered on the left margin of the receptacle, while the right presents an unbroken line from the foot nearly to its summit. The habitat of the host has been already mentioned under *P. curvata*, and both species have been found on a single individual.

PEYRITSCHIELLA NIGRESCENS Thaxter. Plate VI, figs. 22, 23.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 184.

Receptacle sub-triangular in form, consisting of a single basal nearly hyaline cell followed by the usual three series, the lower broadly edged with black on either side, consisting of a long median cell from which three cells are cut off on the right and two on the left; the middle series of about ten cells, which form slight blunt appendiculate projections on either side, extending much higher on the left than at the right, where the single antheridium is situated; the upper series shorter than the middle, bearing the single stout, asymmetrical perithecium, on either side of which are several short appendages asymmetrically placed. Perithecia, 65 × 19 μ. Receptacle, 70 × 37 μ. Total length, 130 μ.

On *Philonthus debilis* Grav. Waverly, Mass.

The single type from which the above description is drawn was found on one of the posterior legs of its host, the figures given representing an anterior and posterior view of the same specimen. The compact sub-triangular form of the receptacle and the stout perithecium connect it more closely with *P. minima* than with either of the other species; while the external blackening of its lower cell series suggests some of the species of Dichomyces. In its asymmetrical development and single antheridium, however, it corresponds exactly to the type structure of Peyritschiella. The perithecium of the unique type is not quite mature, and more fully developed material may show that its apex becomes characteristically papillate as in the other species.

DICHOMYCES Thaxter. Plate VI, figs. 25–36; Plate VIII, figs. 11–14.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 183.

Receptacle flattened, sub-triangular; consisting of a single basal cell followed by three transverse series of cells symmetrically placed; the distal row bearing a pair of perithecia symmetrically placed; or a single perithecium, the fellow of which is undeveloped, together with certain sterile appendages; the sub-distal row producing a pair of compound antheridia symmetrically placed and subtended by one or more sterile appendages. Perithecia symmetrical. Spores once septate. Appendages and antheridia as in Peyritschiella.

This genus, although very closely related to Peyritschiella, is distinguished by the bilateral symmetry which characterizes not only the arrangement of the cells of the receptacle itself, but of the organs produced from it, namely, the antheridia and perithecia; although in a single species (*D. inæqualis*) one perithecium only is developed, which is, however, placed symmetrically in relation to the cell from which, in the other species, a second perithecium arises. Apart from this bilateral symmetry, the structure and development of the members of the two genera are identical, and were it not for the fact that of the eight species included by them, four correspond exactly to one, and four to the other type, the two genera might readily be united. The four species of Dichomyces are among the most striking and curious in form of all the Laboulbeniaceæ. They have been found thus far only on beetles belonging to the Staphylinidæ, such as inhabit rather dryer situations, in most cases common among rubbish in cultivated fields.

In the following descriptions the face bearing the antheridia is spoken of as anterior.

DICHOMYCES FURCIFERUS Thaxter. Plate VI, figs. 25–29.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 184.

Receptacle consisting of a small basal cell, which is nearly hyaline distally and suffused with brown basally, the receptacle above gradually expanding into a more or less fan-like form, the basal portion wholly black and opaque, the blackened area extending upward externally and including a prong-like projection with one or two appendages at its base, which extends above the base of the perithecium and forms the terminal portion of the sub-distal transverse series of cells on either side; the latter, seven in number, becoming generally suffused with blackish brown, the long rectangular median cell usually more or less distinct, the remainder partly or wholly opaque and indistinguishable; the antheridia lighter brownish. The distal row of cells seven in number, their septa straight, thin, and clearly defined; the middle cell of the series bearing distally two appendages, placed antero-posteriorly, the terminal cells of the series on either side also bearing two appendages, the inner slightly anterior. Perithecia bent slightly forward, tapering very slightly to the blunt apex, which bears a short, recurved, tooth-like projection on either side from each anterior lip-cell. The perithecia and distal row of cells faintly tinged with reddish purple. Appendages short, simple, hyaline, cylindrical, with a constricted blackish base. Perithecia, $63 \times 16–18\,\mu$. Receptacle: length to base of perithecia about $90\,\mu$; to tips of external projections, $100–120\,\mu$; greatest width, $55–60\,\mu$.

On *Philonthus debilis* Grav., Waverly, Mass., and Kittery Point, Maine.

A most singular plant looking like a two-pronged fork or a pair of inverted pincers, between the black arms of which arise the two perithecia. The lower portion of the receptacle is so opaque that the cell structure is indistinguishable; but, as far as it can be made out, the lower transverse series of cells consists of a long median cell, on either side of which two, perhaps three, cells are cut off in a fashion similar to that represented in the figure of *D. princeps* (Plate VIII, figs. 11–12). In the present, as well as in the remaining species, the appendages vary somewhat in number according to the number of terminal cells in the distal and sub-distal series, which is not quite constant; and, in the majority of individuals, but few of the appendages remain unbroken at maturity. Of the two appendages situated between the perithecia, one represents the original terminal appendage of the germinating spore. The general form of the receptacle is quite characteristic, and in the region of the distal series of cells it is distinctly concave on the anterior side, the posterior face being somewhat convex.

From the fact that its host is dark-colored, while the parasite itself is partly blackened, it is often very difficult to detect, lying, as it generally does, appressed against the surface of the former. It sometimes occurs, however, in such large numbers that it is seen without any difficulty, and in such cases, although it is usually found on the under surface of the abdomen, it may extend to the legs, thorax and all parts of the body of its host. Its natural position seems to be with the tip of the perithecium turned toward the extremity of the insect's body, and the anterior face turned inward, the perithecia being turned slightly backward (upward). Although the host is very common, this species, like its relatives in the genus, seems to be decidedly rare.

Dichomyces inæqualis Thaxter. Plate VI, figs. 30–34.

Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 103.

Receptacle as in *D. furciferus*, its fork-like projections prominent and indistinctly septate, the distal row of cells bearing a single perithecium; otherwise symmetrical, except that the submedian cell, above which a second perithecium arises in *D. furciferus*, is much reduced in size. Appendages ten to twelve, one external to and near the base of each antheridium, two above the median cell of the distal row, and three to four borne one from each of the three to four cells of the distal row external to the sub-median cells, all arising as in *D. furciferus*. Perithecium large, slightly inflated towards the base; or sub-cylindrical, tapering abruptly at the extremity to a subtruncate apex destitute of appendages. Spores, 26 × 3.5 μ. Perithecia, 100 × 25 μ. Receptacle, length to base of perithecium, 92 μ; length to tips of lateral forks, 110–130 μ; greatest breadth, 50–60 μ. Total length to tip of perithecium, 180–190 μ.

On *Philonthus debilis* Grav. Kittery Point, Maine, and Waverly, Mass.

This species occurs, sometimes in company with *D. furciferus*, on the abdomen, more rarely on the legs and thorax of its host. It is at once distinguished by its solitary perithecium, which is destitute of the terminal outgrowths peculiar to the last named species. It is much more common in the localities mentioned than its ally, and in none of the numerous specimens examined does there appear to be any variation in the points of structure which distinguish it. In no instance was any attempt observed to produce the usual pair of perithecia, and the single perithecium, by its larger size, somewhat different form, and abruptly truncate apex, serves readily to distinguish it.

Dichomyces infectus Thaxter. Plate VI, figs. 35–36.

Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 102.

Receptacle consisting of a short basal cell succeeded by an axile cell placed vertically, on either side of which a series of three obliquely superposed cells forms a blackened border. The remainder of the receptacle consists of two successive transverse symmetrical rows of cells, the lower row made up of three central and several smaller external cells, terminating on either side in a short, blunt projection below the prominent antheridia; beside which arise externally single sterile appendages. The distal row is composed of seven cells, the external cells on either side not extending beyond the bases of the perithecia and destitute of appendages; two appendages arise between the perithecia, one on either side. Perithecia two, closely approximated, arising from single broad, flattened cells, short and stout, tapering slightly toward the sub-truncate apex, which is destitute of papillæ or appendages. Perithecia, $66 \times 22\ \mu$. Receptacle, $60 \times 40\ \mu$.

On *Xantholinus obsidianus* Melsh. Waverly, Mass.

Two specimens of this small form were found at the tip of the abdomen of its host, only one of which is preserved as the unique type of this well-marked species. Its broad, stout perithecia, and the absence of any external appendages on the distal series of cells, distinguish it readily from other species. Although sought for diligently, it has been found but once, notwithstanding the fact that its host is a beetle common in cultivated fields, where it may be found running over freshly turned soil or concealed in decaying vegetable matter.

Dichomyces princeps Thaxter. Plate VIII, figs. 11–14; Plate II, fig. 11.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 479.

Nearly hyaline, becoming slightly and uniformly tinged with pale reddish brown, sometimes narrowly edged with blackish near the base. Receptacle large, consisting of a single small squarish basal cell, above which are three successive transverse rows of cells placed side by side, the upper margin of each series convex; the lower series consisting of a long narrow axial cell, with three or four more or less obliquely superposed cells on either side; the middle series consisting also of an axial cell, with five to eight cells on either side, which extend obliquely upward and outward to form a free rounded projection, each cell of which bears a short appendage, the antheridia prominent at the base of each projection; the third or distal transverse series like the second, the cells often slightly more numerous, forming projections in a similar fashion on either side which bear the same short appendages. The axial cell of the terminal series is followed by two small cells, each bearing a short appendage, on either side of which a large somewhat flattened cell forms the base of the perithecium. Perithecia two, more or less divergent, elongate, slightly inflated and tapering rather gradually to the blunt apex. Perithecia, $110–165 \times 22–30\ \mu$. Spores, $38 \times 4\ \mu$. Receptacle, $150–180 \times 70–75\ \mu$.

On *Philonthus sordidus* Grav. Waverly, Mass.

This fine species is by far the largest and most conspicuous member of the genus, and, owing to the absence of any deeply blackened portions, illustrates the typical form more clearly

than any of its allies. I have met with it on one occasion only, when several hosts were collected from a heap of rubbish near cultivated land, on which the parasite occurred in great numbers, thickly covering the lower surface of the abdomen and extending to the legs and thorax. Unfortunately, all but one of these hosts made their escape in transit, but the single one remaining has furnished abundant material of the mature form. Owing to its light color, large size, and more than usually divergent, though not erect, habit of growth, it is not readily overlooked on the black abdomen of its host.

CHITONOMYCES Peyritsch, Plates VIII and XXVI.

Sitz. d. k. Acad. d. Wiss. LXVIII, p. 250 (1873); Heimatomyces Peyritsch, l. c. p. 251; Heimatomyces emend., Thaxter. Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 30.

Receptacle consisting of a basal and a terminal portion; the former consisting of two superposed cells, and three or four upper smaller cells which form the base of the perithecium; the latter consisting of four cells lying beside the perithecium, the terminal cell always free, originally more or less dome- or bell-shaped, bearing a single terminal appendage, and sometimes becoming otherwise modified at maturity; the sub-terminal cell connected on its inner side with, or rarely free from, the two cells below it, from the upper of which is separated a small cell that bears terminally, in the angle formed by the perithecium and the receptacle, one or two appendages, beside which is situated the usually small antheridium (?). Appendages slender, filamentous, simple, aseptate or spuriously septate, hyaline, evanescent, the base blackened and slightly constricted. Perithecium more or less completely united to the distal portion of the receptacle, each series of wall-cells containing not more than six cells, some of which may be appendiculate; the apex often variously modified. Spores fusiform, once septate.

Since the description of numerous species under the name Heimatomyces, I have had an opportunity of examining specimens of *Chitonomyces melanurus* Peyritsch, and, as I formerly suggested, the two genera prove identical. I have therefore concluded to use the latter name to distinguish the genus; since, although I very much dislike to regard the rules of priority at the expense of those of common sense, it seems desirable that the nomenclature adopted in the present monograph should be, in so far as possible, a fixed one, and the name Chitonomyces undoubtedly has precedence in the present instance to the extent of nearly half a page.

The genus is one the position of which has been, until the present paper was in press, quite uncertain; the character of the sexual organs not having been ascertained with sufficient exactness to warrant any definite statement concerning them. The very recent discovery, however, of an undescribed and very closely allied aquatic genus, in which the antheridium is so placed that it can be readily seen, renders its position no longer doubtful, and confirms my first impression, which was based on the general resemblance of its appendages and the structure of its receptacle to those of Peyritschiella. The new genus, a description of which is necessarily reserved for a succeeding supplement, is characterized by a general structure curiously intermediate between that of Chitonomyces and the genus last mentioned, the small but very definite compound antheridium occupying a position on the anterior margin of the plant just below the base of the perithecium.

In the present genus, the antheridium, or what I have taken to be that organ, lies just beside the bases of the lower appendages, and has not been satisfactorily made out, owing to the small size and lack of definition in the cells lying in this region. In *C. rhyncostoma*, what appears to be the neck of the antheridium becomes enlarged, as the individual matures, and projects as a conspicuous hook-like prominence from the angles between the perithecium and the appendage (Plate XXVI, fig. 18). The character of the trichogyne is also a matter of uncertainty, and although I have definitely made out the carpogenic and trichophoric cells, the latter terminating close beside the supposed antheridium, I have been quite unable to determine whether one of the two "appendages" was in reality a trichogyne or whether, as is more probable, the latter is reduced merely to a slightly inflated prominence. Owing to the minute size of a majority of the species, and the difficulty in obtaining material of young individuals, the determination of these matters is by no means easy, and involves an expenditure of time that I have been unable to afford.

In other respects the structure of the members of the genus is well defined and remarkably constant; although the perithecium is subject to curious variations of form, and the terminal portion of the receptacle, especially its terminal cell, is often so modified as to obscure its true structure. In *C. melanurus*, for example, the terminal and the sub-terminal cells are, at maturity, opaque and indistinguishable, the former becoming proliferous below its original apex and developing a hook-like extremity, the insertion of the originally terminal appendage being turned to one side, and visible only as a slight prominence from its inner margin (Plate XXVI, fig. 19). A somewhat similar modification is seen in *C. marginatus*, in which the whole distal portion of the receptacle becomes blackened, and the terminal cell is similarly proliferous (Plate XXVI, figs. 20 and 21; Plate VIII, fig. 27). The curious outgrowths from the wall-cells of the perithecium are remarkable from the fact that they are not confined to any special cell or even cell-series, being quite variable in position, as in *C. paradoxus*, *C. appendiculatus*, *C. spinigerus*, *C. uncinatus* and others. The appendages closely resemble those of Peyritschiella, and are very slender and evanescent, being usually completely broken off in mature specimens, the blackened bases alone remaining. The more or less dome-like cell which bears the terminal appendage is identical with the similar cell which bears this appendage in the last-mentioned genus.

Reference has already been made to the form of the foot, which is peculiar to this and the succeeding genus, and seems undoubtedly designed to allow a greater freedom of motion necessitated by the exigencies of life in the water on a rapidly moving host. The base of the foot, by which alone it is attached to the host, is rather narrow and pointed, while the upper portion is more or less rounded, and serves as a fulcrum on which the individual may roll from side to side through a considerable arc. The remarkable constancy with which the different species occur in definite positions has also been previously alluded to (p. 246); and, as will be seen, is practically invariable in every instance. All the species are aquatic, and are, so far as known, confined to hosts belonging to the family Dytiscidæ.

As in previous instances, the side bearing the perithecium is considered anterior, the lower appendages are thus described as arising from the left side. It may be remarked in passing that species credited to Connecticut only are undoubtedly as widely distributed as the others, this being the only locality in which they have been carefully sought for.

Chitonomyces paradoxus (Peyritsch). Plate VIII, figs. 17–21.

Heimatomyces paradoxus Peyritsch, Sitz. d. k. Acad. d. Wissen. Bd. LXVII, p. 251; Wien, 1873, Plate III, figs. 35–39; Winter, Die Pilze Deutschl. II, p. 525, p. 920, fig. 5; Sorokin, Veg. Par. of Man, etc., p. 425, Plate XXXII, figs. 763, 770; Saccardo Sylloge, Vol. VIII, p. 915; Berlese, Malpighia, Vol. III, p. 60; Thaxter, Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 32.

Pale straw color becoming tinged with amber brown. Perithecium asymmetrical, the irregular lip-cells lateral and internal, the sub-terminal wall-cells of one of the external series produced to form a pointed terminally curved outward horn-like projection; a prominent ridge extending transversely on the left side from about the centre of the perithecium across the sub-terminal cell of the receptacle. Receptacle of the usual form, the basal cell large, the sub-basal cell flattened, the terminal and sub-terminal cells projecting almost wholly free beside the perithecium. Spores strongly curved, fusiform, $65 \times 7\ \mu$. Total length to tip of perithecial horn about 225 μ; to tip of receptacle, 150–185 μ. Greatest width, 60–75 μ.

On *Laccophilus maculosus* Germ., New England; on *Laccophilus* sp., Kansas (Barber); on *L. minutus* Sturm., and *L. hyalinus* Dej., Europe (Peyritsch).

This species, which is the largest of the genus, occurs invariably on the outer margin of the left elytron, somewhat beyond the middle, where it grows in groups of from two to half-a-dozen, and is very easily seen from its large size. It is not uncommon, and is not to be confused with any other species from the terminal, horn-like outgrowth of its perithecium.

Chitonomyces appendiculatus Thaxter. Plate XXVI, figs. 25–26.

Heimatomyces appendiculatus: Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 31.

Becoming faintly brownish. Perithecium tapering to a rather sharp apex, curved strongly outward, hunched externally and bearing a straight, sub-clavate, one-celled, brownish appendage arising externally some distance below the apex, projecting outward and upward at an angle of about 45°. Basal cell of the receptacle rather narrow, twice as long as the squarish sub-basal cell. Spores, $32 \times 3\ \mu$. Perithecia, $55 \times 15\ \mu$ to $75 \times 22\ \mu$. Basal and sub-basal cells, 30–45 μ in length. Perithecial appendage, $30–33 \times 4\ \mu$. Total length to tip of perithecium, 100–130 μ. Greatest breadth, 30–36 μ.

On *Laccophilus maculosus* Germ., Connecticut.

A rare species, confined to the anterior pair of legs of its host, and distinguished at once by its clavate perithecial appendage, which corresponds to the similar horn-like projection from the perithecium of *C. paradoxus*, but is very different in form and in its relation to the other parts of the perithecium.

Chitonomyces distortus Thaxter. Plate XXVI, figs. 29–30.

Heimatomyces distortus. Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 477.

Pale yellowish, more or less clavate in general form. Perithecium inflated, its external margin strongly curved, becoming abruptly constricted below a long, slender, tubular, terminal

mouth, which is usually, but not always, bent abruptly outward almost at right angles to the nearly straight inner margin of the perithecium. A short, straight, bluntly-pointed, rather stout appendage arises on one side only of the perithecium, just below this tubular apex beyond which it projects. The basal and sub-basal cells of the receptacle about equal in length, the latter broader: distal portion of the receptacle composed of the usual four cells, the sub-terminal cell forming a distinct external prominence below the terminal cell, which is bent toward and partly overlaps the perithecium. Perithecium (main body), 60 × 18 μ, its tubular apex, 18–25 × 6 μ. Spores, 20 × 3 μ. Length of receptacle, 110 μ.

On *Laccophilus maculosus* Germ., Connecticut.

A singular species appearing at first sight malformed or abnormal. It occurs in company with *C. appendiculatus* on the anterior legs of its host, and is at once recognized by the tubular prolongation of the apex of its perithecium.

Chitonomyces spinigerus Thaxter. Plate VIII, figs. 15–16.

Heimatomyces spinigerus: Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 478.

Brownish yellow. Perithecium small, its tip slightly exceeding that of the receptacle; its extremity blunt, lobed, curved outward, and bearing two projections unequal in size just below the tip, one of which extends outward beyond the perithecial margin as a blunt prominence. Basal cell of the receptacle often bent, expanding distally, much longer than the flattened sub-basal cell: the distal portion of the receptacle with greatly thickened external walls, and consisting of the usual four cells, the terminal one short, with a broad base and bent towards the apex of the perithecium. Three small cells are distinct below the perithecial cavity, from the outer of which is produced externally a prominent spur-like process. Perithecia, 55 × 15 μ. Total length to tip of perithecium, 88–90 μ. Spur-like process, 12–30 μ long.

On *Laccophilus maculosus* Germ., Connecticut.

Distinguished from all other species by the spur-like process from the base of the perithecium. The septa are all defined with unusual clearness, the external walls being greatly thickened. Apparently among the rarest of the twelve species inhabiting this host.

Chitonomyces uncigerus Thaxter. Plate XXVI, figs. 27–28.

Heimatomyces uncigerus: Proc. Am. Acad Arts and Sci. Vol. XXX, p. 478.

Pale yellowish. Perithecium moderate, rather broad, its outer edge straight, its upper fourth free from the receptacle, its prominent bluntly-tipped extremity bent abruptly outward at right angles: a slender hooked appendage arises from a point close to the receptacle about two-thirds of the distance from the base to the apex of the perithecium, projecting from it obliquely outward. Basal cell of the receptacle large and long, the sub-basal cell small, sub-rectangular, flattened: the distal portion composed of the usual four cells, the terminal one not very prominent, and bent strongly toward the perithecium. Perithecia, 80 × 22–25 μ. Spores, 45 × 4 μ. Perithecial appendage about 22 μ long. Receptacle, 132 μ long. Total length to tip of perithecium, 135 μ.

On *Laccophilus maculosus* Germ., Connecticut.

The more or less wedge-shaped apex of the perithecium of this very distinct form projects outward abruptly at right angles to the straight outer perithecial margin. The hook-like appendage is quite unlike that of any other species in form and position, and, occurring only on one side, is not seen unless the perithecium lies at the right. It occurs with *C. spinigerus*, *C. hyalinus*, and rarely *C. marginatus*, on the posterior legs of its host.

CHITONOMYCES MELANURUS Peyritsch. Plate XXVI, fig. 19.

Sitz. d. k. Acad. d. Wissen., Bd. LXVII, p. 251, Plate III, figs. 30–34; Wien, 1873; Winter Die Pilze Deutschl., Bd. II, p. 924, p. 920, fig. 4; Sorokin, Veg. Par. of Man, etc. Vol. II, p. 424, Plate XXXII, fig. 771; Saccardo Sylloge, Vol. VIII, p. 914; Berlese, Malpighia, Vol. III, p. 59.

Straw colored, becoming faintly brownish. Perithecium slightly inflated near its base, its sub-terminal wall-cells expanded to form a projection from the outer and inner margin, each of which extends a little beyond the small hyaline apex which lies between them; the outer projection smaller and distinctly brownish, the inner nearly twice as broad and hyaline. The two lower cells of the receptacle nearly equal, forming a rather slender basal portion, above which it expands somewhat abruptly: the terminal and sub-terminal cells deeply blackened, the latter proliferous externally below the insertion of the appendage, which is thus turned inward, and becomes lateral in position, the proliferation extending some distance beyond it, and forming a terminal, translucent, outwardly turned hook. Length of perithecium, 95–100 μ. Total length to tip of perithecium about 150–160 μ; to tip of receptacle, 145–150 μ. Greatest width, 30–35 μ.

On *Laccophilus minutus* Sturm. and *L. hyalinus* Dej., Europe.

This peculiar species, which is the type of the genus, does not appear to occur in this country, its place being taken curiously enough by the succeeding species, which occurs in exactly the same position often in company with *C. paradoxus*, and exhibits a somewhat similar proliferation of the terminal cell of the receptacle. The material from which the accompanying figure and description were derived was found on a specimen of *Laccophilus* from Germany in the collection of the Museum at Cambridge. Although Peyritsch placed it in a genus distinct from *C. paradoxus*, there is no doubt whatever as to the generic identity of the two forms.

CHITONOMYCES MARGINATUS Thaxter. Plate XXVI, figs. 20–22; Plate VII, figs. 25–27.

HEIMATOMYCES MARGINATUS: Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 34.

Long and slender, at first nearly hyaline, then yellowish. Perithecium straight, then suddenly bent inward below the hyaline, neck-like, strongly curved tip. Basal cells of the receptacle sub-triangular, the sub-basal half as large as the basal, the three cells at the base of the perithecium more than usually developed: the terminal cells all becoming black and opaque at maturity; the terminal one continued by a squarish outgrowth basally hyaline, at first lateral and external, becoming terminal (the true apex of the cell being pushed inward and becoming lateral), hardly exceeding the tip of the perithecium, which it conceals. Spores, 30 × 3 μ. Perithecia, 95–110 × 22 μ. Total length to tip of perithecium, 140–160 μ. Basal cells of receptacle, 25 μ.

On *Laccophilus maculosus* and *Hydroporus spurius*, Connecticut, Maine; *Laccophilus* sp., Kansas, Barber.

A form peculiar for the modification of the terminal cells of the receptacle, which makes the perithecium appear as if bordered by a black band. It is found in company with *C. paradoxus*, and recalls in some respects the preceding species, which is similarly associated on the left elytron of its host. In one instance a few specimens were found on the left posterior leg, but such a position is exceptional.

Chitonomyces rhyncostoma Thaxter. Plate XXVI, figs. 17–18.

Heimatomyces rhyncostoma: Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 33.

Evenly suffused with dull amber-brown. Perithecium relatively large, the broad extremity abruptly hooked inward, so that the papillate apex becomes lateral and internal; the external series of wall-cells prominent with conspicuous septa. Basal cell of the receptacle rather short, somewhat inflated; the sub-basal cell much flattened; the terminal and sub-terminal cells about equal in length, forming together an outwardly-curved, finger-like projection, exceeding the perithecium: a short but rather conspicuous hook-like structure (antheridium?) arises from the angle between the perithecium and the receptacle on the left side. Spores, $26 \times 3\ \mu$. Perithecia, $75 \times 22\ \mu$. Total length to tip of perithecium, $100\ \mu$. Basal portion of receptacle, 25–30 μ long.

On *Laccophilus maculosus* Germ., and *Hydroporus spurius* Lec., Connecticut.

This species occurs rather rarely on the margin of the right elytron in a position corresponding to that occupied by *C. paradoxus,* but nearer to the middle. The broad hooked apex of the perithecium, coupled with the finger-like development of the distal portion of the receptacle, serve at once to distinguish it from known species. The hook-like projection, which arises near the base of the lower appendages, has already been alluded to in the previous description of the genus, and may be the antheridium.

Chitonomyces lichanophorus Thaxter. Plate XXVI, figs. 15–16.

Heimatomyces lichanophorus: Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 32.

Hyaline except for the suffused basal cell. Perithecium bent outward at an angle from the basal part of the receptacle, tapering slightly to the papillate apex. Basal cell of receptacle enlarged and greatly elongated, more or less intensely blackened above its hyaline base; sub-basal cell flat and almost obsolete. Terminal and sub-terminal cells together forming a straight, finger-like projection as long as or longer than the perithecium, on which the appendage is terminal. Spores, $33–37 \times 2.5–3\ \mu$. Perithecia, $65–90 \times 30\ \mu$. Total length to tip of perithecium, 150–180 μ. Basal cell, 90–110 μ.

On *Laccophilus maculosus* Germ., Connecticut.

This species is confined to the median inferior anal plate of its host, and has only been observed upon males. It is not to be confused with any other species, being distinguished by its elongated basal and apical cells, almost black and white color, and papillate divergent perithecium. *C. rhyncostoma*, which has a very similar finger-like prolongation of the terminal portion of its receptacle, is at once separable by the basal cell, and the form of its perithecium.

Chitonomyces uncinatus Thaxter. Plate XXVI, fig. 23–24.

Heimatomyces uncinatus: Proc. Am Acad. Arts and Sci. Vol. XXVII, p. 33.

Evenly suffused with pale amber-brown. Perithecium large, curving evenly inward to the somewhat pointed apex. Basal cells of the receptacle rather slender, the terminal cell pushed to one side and bent past the apex of the perithecium by a somewhat indurated, blunt outgrowth from the sub-terminal cell, the tip of which it nearly equals. Perithecia, 75–85 × 20 μ. Total length, 110–130 μ. Basal cells of receptacle, 37 μ.

On *Laccophilus maculosus* Germ., and *Hydroporus spurius* Lec., Connecticut.

A rather rare species, occurring in groups on the inferior surface of the abdomen of its host, and distinguished by the peculiar development of the sub-terminal cell of the receptacle, which gives its extremity a somewhat hooked appearance.

Chitonomyces affinis Thaxter. Plate XXVI, figs. 12–14; Plate VIII, figs. 29–30.

Heimatomyces affinis: Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 31.

Rather strongly suffused with amber-brown. Perithecium commonly slightly curved inward, or nearly straight, the tip often slightly bent outward. Basal cell of receptacle large, sub-triangular, suffused laterally and terminally with deep black-brown: sub-basal cell very flat; terminal cell small, its axis bent strongly inward. Spores, 50–55 × 3 μ. Perithecia, 100–110 × 30 μ. Basal and sub-basal cells of receptacle, 40–45 μ. Total length to tip of perithecium, 150–170 μ.

On *Laccophilus maculosus* Germ., and *Hydroporus* sp., Connecticut.

This species occurs near the margin of the right elytron toward its tip, and is distinguished from other species of the more simple forms by its large, blackened basal cell and the position of the terminal cell of the receptacle, which is bent against the perithecium on the left side, and is partly concealed by it when viewed from the right. It is one of the commonest species, and is easily detected from its dark color.

Chitonomyces hyalinus Thaxter. Plate XXVI, figs. 10–11.

Heimatomyces hyalinus: Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 31.

Hyaline or very faintly tinged with yellowish brown. Perithecium large; at first hunched externally and bent inward near the apex; at maturity becoming nearly straight, tapering slightly to the rather narrow apex, which is bent somewhat abruptly outward; one or two oblique ridges more or less distinct below the apex on the inner margin, the walls of the cells composing the outer margin greatly and often very abruptly thickened below the tip. Basal portion of the receptacle rather short and stout, the two lower cells nearly equal. Spores, 30 × 2.5 μ. Perithecia, 75–90 × 20 μ. Total length to tip of perithecium, 110–120 μ.

On *Laccophilus maculosus* Germ., Connecticut.

This species, although it possesses few striking characteristics, is yet quite distinct from any of the others, its chief peculiarity consisting in the fact that the walls of the cells composing the

outer margin become abruptly thickened below the tip. The oblique ridges, which are often very distinct below the apex on the inner side, and the abrupt outward curvature of the latter at maturity serve also to separate it from other known species. It is rather rare and detected with some difficulty.

Chitonomyces simplex Thaxter. Plate XXVI, figs. 1–3.

Heimatomyces simplex: Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 30.

Pale yellowish or faintly brownish. Perithecium rather slender, continuing the strong curve of the receptacle evenly outward to its rather coarse blunt straight tip. Basal cell of the receptacle much longer than the flattened sub-basal cell: terminal cell bell-shaped, small, the whole distal portion of the receptacle evenly curved parallel to the perithecium. Spores, $26 \times 11\ \mu$. Perithecia, $55–60 \times 11–12\ \mu$. Length of receptacle, $75\ \mu$. Basal cell, $15 \times 7.5\ \mu$. Total length, $90–100\ \mu$.

On *Laccophilus maculosus* Germ., *Hydroporus spurius* Lec., Connecticut.

A common species, occurring in considerable numbers on the elytra of the host, near the middle of the distal portion, possessing the simple typical structure of the genus, and distinguished by its evenly curved habit, and the prominent blunt almost cylindrical terminal portion of the perithecium.

Chitonomyces Bidessarius Thaxter. Plate XXVI, figs. 4–5.

Heimatomyces Bidessarius: Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 185.

Hyaline, becoming faintly tinged with blackish. Perithecium small, stout, its upper third or fifth free from the receptacle, the apex bent outward, the basal portion straight, the tip broad, with large, prominent lips. Receptacle stout, the two basal cells more nearly equal, the two cells above these longer than broad and nearly equal; distal portion nearly as in *C. borealis*, the base of the short terminal cell horizontal. Perithecia, $40–48 \times 15\ \mu$. Receptacle, $65\ \mu$ long. Total length to tip of perithecium, $80\ \mu$.

On *Bidessus granarius* Aube, Kittery Point, Maine.

This is among the smallest of all the Laboulbeniaceæ, and though presenting no great peculiarities, is distinguished by its stout form as well as the short and very broad but not abruptly distinguished tip. It occurs in various positions on the upper surface of the elytra of its minute host.

Chitonomyces borealis Thaxter. Plate XXVI, figs. 8–9.

Heimatomyces borealis: Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 185.

Hyaline or slightly yellowish. Perithecium large and stout, its distal half or more free from the receptacle, tapering slightly to the large blunt apex. Sub-basal cell of the receptacle small and flattened: the distal portion of the receptacle composed of only three cells (the fourth obsolete or very minute), the distal one large, longer than broad, its base very oblique, the two others very long and sub-triangular, the septum between them running obliquely from the insertion of

the "trichogyne" nearly to the base of the inner cell. Perithecia, 80–90 × 22 μ. Receptacle, total length, 75–80 μ; length to tip of perithecium, 110–120 μ.

On *Desmopachria convexa* Aube, Kittery Point, Maine, and New Haven, Connecticut.

This species differs from those previously described by the apparent absence of the fourth cell in the distal portion of the receptacle. It is related to the preceding species in its cell arrangement, but is easily separated by its greater size, the relative position and shape of the perithecia, etc. The ascogenic cell faces outward, a position which seems exceptional. It is apparently rare, and occurs in small numbers on the anterior legs of its host.

Chitonomyces aurantiacus Thaxter. Plate XXVI, figs. 6–7.

Heimatomyces aurantiacus: Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 103.

Pale straw-colored, the cell contents including numerous rather bright orange granules or oil globules. Perithecium exceeding the tip of the receptacle by from one-fifth to one-quarter of its length, small, slender, the tip usually curved outward, the lips rather prominent, its external basal cell marked by more or less distinct and very fine transverse ridges. Receptacle slender, the basal cell suffused with brown below, the sub-basal cell small and flat, the two succeeding cells elongate, the outer shorter and continued above by an unusually large basal cell of the perithecium: distal portion of the receptacle, as in *C. borealis*, composed of three cells, the two lower very long and narrow, sub-triangular, obliquely superposed, their lower extremities nearly touching the sub-basal cell. Perithecium, 50 × 14–15 μ. Total length to tip of receptacle, 85–90 μ; to tip of perithecium, 100–110 μ. Greatest breadth, 22 μ.

On *Desmopachria convexa* Aube, Kittery Point, Maine.

A rare species occurring on the right elytron near the middle of its distal half. Distinguished from *C. borealis*, which occurs also very rarely on the same host, and *C. Bidessarius*, by its slender form and orange color as well as the details of its structure. It is a very delicate species, seldom found in good condition. The striation of the outer basal cell of the perithecium is very characteristic, but not always distinct.

HYDRÆOMYCES nov. gen. Plates XXVI and VIII.

Receptacle consisting of a basal and terminal portion, the latter united to the perithecium along its inner margin and terminating in a sub-conical, terminally appendiculate free cell, the cell below the sub-terminal cell producing from its left face three outgrowths, which extend upward, and are separated as cells, ending like the terminal cell in a sub-conical body bearing a single terminal appendage and almost completely concealing the face of the sub-terminal cell: the basal portion consisting of three superposed cells, above which three or perhaps four cells form the base of the perithecium. The wall-cells of the latter arranged in four longitudinal series, each of which contains more than six (eight) cells. Spores fusiform, once-septate.

In view of the invariable character of the fundamental cell structure and arrangement in the sixteen species composing the genus Chitonomyces, to which the single form included by the present genus was first referred, and the very distinct variations from this type presented by

the latter, I have concluded to separate it, basing the new genus on the greater number and different arrangement of the small appendiculate cells bearing the lower appendages, the different number of wall-cells in the perithecium and the fact that three of the lower cells of the receptacle are superposed. The genus Chitonomyces, although so closely allied, shows no variation in these respects. The relation of the mature perithecium to the insertion of the trichogyne, and the considerable growth of the former beyond it, recalls the similar relation existent in Ceratomyces, while the same is true to a less degree in Chitonomyces. Although these three genera are all aquatic, it does not seem probable that the similarity just referred to indicates any close relationship with Ceratomyces in view of the very different character of the male organs in either case.

As in Chitonomyces, material has been lacking for a proper study of the younger stages of development, and the character of the trichogyne and antheridium has not been made out. In one specimen the procarpe was distinctly seen, and an attempt was made to represent it in fig. 24, Plate VIII. The trichophoric cell here was large and slightly inflated, lying close beside the inner appendiculate cell. The septation in this figure is somewhat misleading from the fact that it does not represent what is visible in a single plane.

There seem to be at least two if not more ascogenic cells in the mature perithecium, but their structure and early development have not been seen. It is needless to say that both these genera are in a most unsatisfactory condition in so far as concerns their development, and were it not for the discovery of the new genus above mentioned as intermediate between Chitonomyces and Peyritschiella, their position would be entirely uncertain. The single form inhabits species of two genera of aquatic beetles belonging to a family (Haliplidæ) no other members of which are known to be attacked by Laboulbeniaceæ.

HYDRÆOMYCES HALIPLI Thaxter. Plate XXVI, figs. 31–33; Plate VIII, figs. 22–24.

HEIMATOMYCES HALIPLI: Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 32.

Strongly suffused with dull amber-brown. Perithecia rather evenly inflated, the extremity evenly rounded, the lip-cells forming a flat, hyaline, abruptly projecting terminal papilla. Basal cell of the receptacle rather long, tapering below, its base suffused with blackish, the two cells superposed above it broader than long, nearly equal: the terminal cell more or less conical, the three lower appendiculate cells nearly as large as the terminal one, and almost completely hiding the sub-terminal cell on the left side. Spores, 30 × 3 μ. Perithecia, 100 × 35–40 μ. Total length to tip of perithecium about 150 μ.

On *Haliplus ruficollis* DeG., and *Cnemidotus muticus* Lec., New Haven, Connecticut, and Kittery Point, Maine.

This species seems by no means common, and is found usually on the right elytron of its host or on the legs. A single specimen only has been found on Cnemidotus.

AMORPHOMYCES Thaxter. Plate V, figs. 17–29.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 158.

Sexual organs borne on separate individuals.

Male individual. Receptacle consisting of two superposed cells, the upper bearing terminally a single simple antheridium.

Female individual. Receptacle consisting of a single cell, above which four (?) small cells form the base of the solitary terminal perithecium. Spores continuous. Asci four spored. Ascogenic cell solitary. Trichogyne a nearly sessile vesicle with short radiate branches.

The above description is based on the characters of the single species *A. Falagriæ*, since it is quite certain that the second supposed species, *A. floridanus*, is generically distinct and not even nearly related to it. The genus is among the most interesting of the whole group, not only from the fact that the sexes are separated on different individuals, but from the peculiarities of its development. It is the only form in which the perithecium is a strictly terminal structure, and, unless it be Dimorphomyces, no other genus has a unicellular receptacle.

The general development of the female is indicated by figures 20–23, the latter showing the first two septa which form in the germinating spore, dividing it into three superposed cells. Of these the lower, which may become partly divided, forms the unicellular receptacle; while of the two others the middle one (*c*) constitutes the primordial cell of the perithecium proper and the upper gives rise to the procarpe.

The development of the male individual is extremely simple. As in the case of the female the spore first divides (fig. 23 at the right) into three superposed cells. Of these three cells the two lower remain unchanged, and may be called the receptacle; although, from analogy with the female, one might infer that the middle cell was morphologically a basal cell of the antheridium. The terminal cell then elongates, producing a long tubular neck through which the antherozoids formed in its basal portion make their escape (fig. 20, at the right).

The spores are unique from the fact that even when fully mature they show no signs of septa; and their contents are exceptional in containing a number of large oil globules (fig. 29). They are always discharged in pairs, the members of which thus develop side by side. It is also an invariable rule, the existence of which has been established by very numerous observations, that, of the members of any such spore pair, one always produces a male and the other a female. Even at the time of discharge there often is observable a slight difference in the size of the two spores (fig. 29), the spore at the left in the figure being somewhat smaller than its fellow. As soon as germination commences (fig. 23) the difference becomes very apparent, and the course of development results which has just been indicated. When the female individual is mature, if care is taken in removing it from its point of attachment, it will always be found that a male individual is attached close to its base, the feet of the two individuals being adherent (fig. 17). A similar juxtaposition of the sexes at the point of growth has already been noted in connection with Dimorphomyces.

The trichogyne bears a striking resemblance to that of the last mentioned genus, and in some instances its radiating branches are furcate, as in fig. 24. The base of the trichogyne, as in the case of Stigmatomyces which has been described in detail elsewhere, is formed from a small cell

that becomes separated from the end of the trichophoric cell, and corresponds to the indurated portion of the trichogyne described in connection with Camptomyces. From this cell the receptive portion of the trichogyne first makes its appearance as a minute papilla, which enlarges and grows out to form the characteristic branches just described.

The development of the perithecium proper has not been followed out in all its details, but seems to correspond closely to that described as typical in the first part of this Memoir. Whether there is a stalk-cell and a secondary stalk-cell has not been determined, but it is probable that one of the two may be absent, since there seem to be but four cells about the base of the perithecium.

I have also been unable to observe the first divisions which take place in the carpogenic cell after fertilization, and it is only after the asci have begun to bud from the ascogenic cell that the interior of the perithecium can be seen with sufficient clearness to determine the nature of the changes which are taking place. At this period, however, the ascogenic cell becomes very distinct, and from its large size is a very good subject for observation. Although it is very long and there is sometimes an indication of a septum across it, its development appears to be identical with that of other cases already described. Its period of activity does not seem, despite its unusual size, to be as great as that of most ascogenic cells; and it is in this genus only that one is very apt to find individuals which have apparently died after completing their period of natural activity.

As in Dimorphomyces, instances sometimes occur in which the spores, not having been discharged for some reason, begin to germinate within the perithecium; and specimens like that represented in fig. 19 are not of very rare occurrence, the blackened foot in such instances being conspicuously developed, as well as faint indications of the three primary septa; but no case of almost complete development like that mentioned in Dimorphomyces (fig. 1) has been observed in the present instance.

The affinities of this very important genus are very obscure. From the character of its antheridium it would be placed in a different group from Dimorphomyces, which occurs on the same host and possesses an antheridium of the compound type very highly developed; yet in some respects it seems to approach this genus as closely as any other. The two genera are often found together on the same host, which is a very small beetle belonging to the Staphylinidæ.

Amorphomyces Falagriæ Thaxter. Plate V, figs. 17–29.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 158.

Male individual consisting of three superposed cells, the basal and sub-basal about equal, the latter suffused with dark brown, the suffusion often extending to the adjacent cells; the distal cell an antheridium, basally slightly inflated, distally prolonged into a cylindrical neck bent to one side. Total length, 48 μ by 10 μ broad.

Female individual. Receptacle hyaline, consisting of a small basal cell, sometimes partly divided, surmounted by usually three small cells more or less irregular in shape and position, which form the base of the large pale brownish yellow perithecium, which is curved strongly on the side opposite the ascogenic cell, and tapers to a blunt almost truncate or abruptly lobed tip.

Spores fusiform, aseptate, containing several large oil globules, about $37 \times 6\,\mu$. Perithecia, $100 \times 30\text{–}33\,\mu$. Total length, $130\text{–}138\,\mu$.

On *Falagria dissecta* Er., Waverly, Mass., and Kittery Point, Maine.

This species is by no means uncommon on the lower surface of the abdomen, where its large projecting perithecia are readily seen at maturity. It also occurs on the upper surface of the thorax and head and more rarely on the legs and the upper surface of the abdomen. It is subject to little variation, figs. 17 and 18 representing almost the extremes of size; although forms sometimes occur slightly larger than that represented in fig. 17.

AMORPHOMYCES FLORIDANUS Thaxter. Plate V, fig. 30.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 159.

Receptacle consisting of a basal cell, partly divided, from which arises on one side (corresponding to the ascigerous side of the perithecium) a somewhat indurated projection which extends upward nearly to the base of the perithecium. Perithecium very large, externally rounded and tapering considerably to the blunt apex, the basal cells, one of which is as large as the rest of the receptacle, forming a short stalk. Spores once-septate about $30 \times 5\,\mu$. Perithecium, $150 \times 52\,\mu$. Receptacle (including stalk-cells of perithecium) $62\,\mu$ long.

On *Bledius basalis* Lec., Florida.

Two specimens of this species were found on the abdomen of a single specimen of its host in the Le Conte collection of Staphylinidæ. As above stated it is almost certainly not an Amorphomyces; yet since the material is not sufficient to form the basis of a new generic diagnosis in the absence of a knowledge of the male sexual organs, it is here retained under the original name until further information can be obtained concerning it. It differs from Amorphomyces in having what appears to be a two-celled receptacle, the sub-basal cell very small and producing on one side a free projection (seen at the right in fig. 30), which is probably an antheridium; whether simple or compound can hardly be determined definitely; while from the other side rises the stalked perithecium, which is larger in proportion to the remainder of the plant than in any other known form. The spores are distinctly once-septate, as seen within the perithecium, and the large ascogenic cell appears to be solitary.

HELMINTHOPHANA Peyritsch. Plate VIII, fig. 10 (after Peyritsch).

Sitz. d. Wien. Acad. LXVIII, p. 250 (1873); *Arthrorhynchus* Kolenati, Wiener Entomol. Monatschrift, I (1857), p. 66.

"Ein gestreckter gegliederter, mit spitzigen Fortsätzen versehener Zweig, scheinbar seitlich zwischen 1. und 2. Trägerzelle des Peritheciums inserirt; Perithecium mit einem Bauch- und Halstheil versehen, der Porus desselben wird von einem mehrlappigen Krönchen umgeben." (Peyritsch l. c.)

This genus, of which I have seen no specimens, appears to be clearly separated from the allied Stigmatomyces through the presence of four instead of one vertical row of antheridial cells in its appendage. As far as can be determined from the figures, the appendage and the

stalk-cell of the perithecium arise from the sub-basal cell of the receptacle, as in so many other cases. The tip of the perithecium is peculiarly modified in the single species; but more exact information is needed on this point.

HELMINTHOPHANA NYCTERIBIÆ Peyritsch. Plate VIII, fig. 10 (after Peyritsch).

Sitz. d. Wien. Akad. LXVIII, p. 250; Sorokin Veg. Paras. Vol. II, p. 423, Plate XXXII, fig. 759: Winter Die Pilze Deutsch. II, p. 924, p. 920, fig. 3; Berlese, Malpighia, Vol. III, p. 58; Saccardo Sylloge Fung. Vol. VIII, p. 913; *Arthrorhynchus Westrumbii* Kolenati, Wiener Entom. Monatschr. (1857), p. 68; Diesing. Sitz. d. k. Akad. d. Wissensch. Wien, 1859, Vol. XXXVII, p. 752, Plate I, figs. 1–3; *Arthrorhynchus Diesingii* Kolenati, l. c. Diesing l. c. fig. 4.

Perithecium brownish yellow, its basal half slightly inflated, abruptly narrowed to the subcylindrical distal half, the apex composed of two series of small roundish cells, the upper forming four papillate prominences around the pore; the base consisting of four small cells terminating a long nearly cylindrical stalk-cell arising from the very small sub-basal cell of the receptacle. Antheridial appendage arising from the sub-basal cell of the receptacle, its lower half consisting of a single cylindrical stalk-cell, its upper of a single sterile cell above which three superposed cells form an axis from which arise the antheridia in four vertical rows. Receptacle of two cells, the basal roundish without any blackened foot. Total length to tip of perithecium, 390–750 μ.

On *Megistopoda Westwoodii* Kol., *Acrocholidia Montaguei* Kol., *Nycteribia Dufourii*, Middle Europe.

The two species described by Kolenati under the genus Arthrorhynchus are said by Peyritsch to be identical, although since they occur on generically distinct hosts it is not impossible that they may prove to be different. The original descriptions being based on supposed zoölogical characters, are quite unintelligible; while the figures of Diesing, apparently drawn from dry material, give no clue to any specific differences.

The hosts are wingless, dipterous parasites of bats, of which I have examined several American specimens, on which no Laboulbeniæ were to be found.

STIGMATOMYCES Karsten. Plate VIII, figs. 1–9; Plate I, figs. 1–26.

Chemismus der Pflanzenzelle, p. 78, Wien, 1869.

Receptacle consisting of two superposed cells, the upper giving rise to the single perithecium on one side and to the single appendage on the other. The perithecium various in form, stalked or sessile, sometimes appendiculate. Appendage consisting of an axis of superposed cells from which are developed on one side a single row of superposed antheridia separated from them by a septum or by a small cell. The antheridial cells flask-shaped, the venters more or less united, the necks projecting independently. Trichogyne simple, short, filamentous. Spores once septate.

This genus, although the three species that it contains are very diverse in form and appearance, is yet clearly characterized by the structure of its antheridial appendage; the latter being unlike that of any other genus with the exception of Idiomyces, which it only remotely resembles. As will be seen by examining the figures on Plate I, the appendage is formed from the

terminal segment of the germinating spore, its basal cell only (figs. 6 and 10 *b*) being derived from the basal spore segment. The process by which the terminal segment becomes septate (fig. 3), and by which the antheridial cells are separated from the cells thus formed, is clearly shown by the series of figures (3–9); and, as will be noted, the antherozoids begin to make their escape some time before the female organ has developed. The origin and development of the procarpe has already been described in detail (p. 218), and further reference to it is unnecessary here.

The mature perithecium varies very considerably in the different species. Not only is its form variable, being rostrate in *S. entomophilus*, clavate in *S. virescens*, and conical in *S. Baeri;* but the relative position of its wall-cells is not the same in either case. *S. virescens* is remarkable from the fact that the position usually assumed by the basal wall-cells is taken by the basal cells of the perithecium, which extend up around the ascogenic cell and some distance above it (fig. 2). The perithecium of this form is moreover peculiar by reason of the appendages which are developed from its lip-cells. According to Karsten, two perithecia are sometimes formed in the same individual of *S. Baeri;* but I have not myself seen such an instance, and it is undoubtedly an abnormal occurrence. In all the species there are four cells in each of the series of wall-cells, although in *S. virescens*, for the reason just mentioned, there appear to be five. The ascogenic cells are four in number in *S. entomophilus* and *S. Baeri;* but in *S. virescens* there seems to be but one; certainly not more than two.

In exceptional instances, in which the female organ has not developed, the cells of the appendage, which would ordinarily have been converted into antheridial cells, may grow out into short secondary appendages, thus, as in other similar instances, greatly increasing the number of antheridial cells. This occurs very rarely in *S. Baeri*, but in *S. virescens* does not appear to be uncommon.

In *S. virescens* the stalk-cell of the perithecium is well developed, but in the other two it is the reverse, so that the latter is nearly or quite sessile. The hosts of the genus belong to the Diptera and Coleoptera.

Stigmatomyces Baeri Peyritsch. Plate VIII, fig. 9 (after Peyritsch); Plate I, figs. 1–26.

Sitz. d. Wien. Akad. Vol. LXVIII, p. 250 (1873); Berlese, Malpighia, Vol. III, p. 57; Winter Pilze Deutsch. Vol. II, p. 923, p. 920, fig. 2; Sorokin, Animal Parasites, Vol. II, p. 418, Plate XXXIII, fig. 788; *Laboulbenia Baeri* Knoch Assembl. d. Natural. d. Russie à St. Pétersb. p. 908 (1867); *Stigmatomyces muscæ* Karsten Chemismus d. Pflanzenzelle (1869), p. 78, fig. IX; Deutsche Flora (1880), p. 123; (1895) p. 119; Hedwigia, Vol. XXVII, p. 137, p. 138, fig. 3; Saccardo Sylloge, Vol. VIII, p. 913; *Laboulbenia muscæ* Peyritsch l. c. Vol. LXIV, p. 444, Plate I; *Laboulbenia Pitræana* Sorokin, Mykologische Versuche, Charkow, 1871, p. 39, Plate IV, figs. 1–9; Bot. Zeitung (1872), p. 339.

Perithecium brownish yellow, its lower half sub-cylindrical stout, somewhat abruptly distinguished from the sub-conical terminal portion; the tip slightly pointed and incurved, the cell rows spirally twisted. The appendage borne on a distinct free basal cell, curved, consisting of five or six obliquely superposed series of cells, the outer cell (antheridium) of each series projecting free from the one or two cells below its base, which may be partly united with the venters of adjacent antheridia. Receptacle consisting of a sub-cylindrical basal and sub-basal cell; the foot rather small and blackened. Total length to tip of perithecium, 230–400 μ (Peyritsch). Perithecium, 140–180 × 40–58 μ. Appendage about 85 μ. Spores, 27–30 × 4 μ.

On *Musca domestica* L., Europe.

I am indebted to Miss Helen Bondy, of Vienna, for material of this interesting form, which I found sufficiently abundant on house flies, of which she was kind enough to send me a large collection. The parasites were attached to all parts of the host, but as a rule were more commonly found on the back of the head and thorax and near the base of the anterior pair of legs and the adjacent portions of the body. Although there seems to be a tendency in the case of female flies to bear the parasite on the upper, and of males to bear it on the lower side, as a result of transference during *coitus*, I have found this condition by no means invariable as stated by Peyritsch. The original account given by Karsten appears to be distinctly more correct than that of Peyritsch; since he not only saw and figured the trichogyne with antherozoids attached, but noted the twisting of the wall-cells of the perithecium, which seems to have been overlooked by the latter observer.

The figure of a mature specimen (Plate VIII, fig. 9) was reproduced from Peyritsch before the material mentioned was obtained; but is sufficiently good for purposes of identification. I have searched for the species in several localities in this country without success; but even if it is not indigenous, it is very improbable that it does not occur here in view of the habits of its host, large numbers of which are being constantly imported from Europe on vessels.

I have not seen the original paper of Knoch in which the species was first described; yet if the title given by Peyritsch is correct, "Laboulbenia Baeri Knoch, einer neuer Pilz auf Fliegen," one cannot agree with the conclusions of Karsten (Hedwigia l. c.) by which the name *Stigmatomyces Muscæ* Karsten is retained.

Stigmatomyces entomophilus Thaxter. Plate VIII, figs. 5–8.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 8; *Appendicularia entomophila* Peck, 38th Report (1885), p. 95, Plate III, figs. 1–4; Berlese and Voglino in Saccardo, Sylloge Fungorum, Additamenta ad Vols. I–IV, p. 354; *Appendiculina entomophila* Berlese, Malpighia, Vol. III, p. 59, Plate II, figs. 1–5; Saccardo Sylloge, Vol. VIII, p. 914. See also Gerke: Wiener Entomol. Zeitung, V, p. 168; Taf. II, fig. 14 (1886).

Perithecium consisting of an ovoid, pale amber-brown base, abruptly narrowed above to form the greatly elongated sub-cylindrical, beak-like, nearly hyaline distal portion. Receptacle tinged with yellowish, long and slender, consisting of a basal and greatly elongated sub-basal cell, followed by two cells, a posterior longer and narrower, which bears the appendage, and an anterior (stalk-cell), separated from the perithecium by four small cells. Appendage small, consisting of a more or less rounded basal cell, bearing the usual series of cells, the venters of the successive antheridial cells more or less completely united, the necks papillate, not very prominent. Spores, $40 \times 3.7\ \mu$. Perithecium, 275–300 μ long, its base about $90 \times 60\ \mu$, its terminal beak about $195 \times 18\ \mu$. Receptacle, $300–325 \times 30\ \mu$. Appendage about 55 μ long.

On *Drosophila nigricornis* Loew., Nyack, New York (J. L. Zabriskie). On *D. funebris* F., Europe (G. Gerke).

I am greatly indebted to its discoverer for several preparations of this curious form, which was originally collected by him on small flies found in a cellar during the month of March. The species is chiefly remarkable for the great elongation of the sub-basal wall-cells of the perithecium, which form almost the whole of its slender, beak-like, terminal portion. Professor

Giard has kindly called to my notice a reference by Gerke in the Wiener Entomologische Zeitung to a parasite on *Drosophila funebris*, found by him in June, 1877. Though his figure is somewhat insufficient, it is more than probable that the plant which he describes is identical with the present species. The figures are evidently drawn from dried and shrivelled specimens, and no appendage is visible, although otherwise they correspond essentially with the American form.

Professor Peck, in his original description, represents the spores as divided by a median septum, but in the material examined they appear to be of the usual type as represented in fig. 8. The host occurs in cellars and similar situations, where it is commonly found hovering over decaying fruit, etc.

STIGMATOMYCES VIRESCENS Thaxter. Plate VIII, figs. 1–4.

Proc. Am. Acad. Arts and Sci. Vol. XIX, p. 106; *Hesperomyces virescens* Thaxter, l. c. Vol. XXIV, p. 264.

Color yellowish green. Perithecium large, clavate or sub-clavate, constricted more or less prominently at the transverse septa between its successive wall-cells, straight on the inner side, rounded externally; the distal series of wall-cells forming the tip, the small terminal cells thus formed producing from four to eight appendages: the outer short or obsolete, the inner consisting of two antero-posterior wedge-shaped prominences, between which lies the pore; and two much longer, divergent, tapering, sometimes septate, lateral appendages. The ascogenic cell perhaps solitary (?), becoming pushed down between the proper basal cells of the perithecium, which thus appears to have five sets of wall-cells. Appendage abruptly constricted at its base, the antheridial cells, usually five in number, distinct, except at the base. Receptacle sharply pointed below, small, sub-triangular, consisting of a basal cell and two smaller terminal cells, the posterior smaller bearing the appendage, the anterior the stalk cell of the perithecium, which equals or exceeds the main body of the receptacle in size. Spores, $65 \times 6\ \mu$. Perithecia, $190–275 \times 66\ \mu$; its longer terminal appendages, $40–45\ \mu$. Receptacle, $75 \times 30\ \mu$. Antheridial appendage, $75 \times 13\ \mu$. Total length to tip of perithecium, $300–400\ \mu$.

On *Chilocorus bivulnerus* Muls., California.

I am greatly indebted to Mr. D. W. Coquillet for two specimens of the above host taken at Los Angeles, which bear the parasite on the legs and on the lower surface of the abdomen; where, owing to its large size and contrasting color, it is readily seen with the naked eye. A further knowledge of the family shows that the characters relied upon for distinguishing the genus Hesperomyces have merely a specific significance; and that while the number of wall-cells of the perithecium appears to be greater than in the other species of Stigmatomyces, they are in reality the same, as indicated in the above description. The receptacle, moreover, may without difficulty be reduced to the same type, although from the obliquity of the septa and somewhat different relative position of its cells, the insertion of the appendage might at first sight seem abnormal. The spores sometimes present a peculiar appearance, through a local inflation of their smaller segment.

IDIOMYCES Thaxter. Plate IX, figs. 16–21.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 162.

Receptacle consisting of two superposed cells, followed by two cells, an anterior and a posterior, — the posterior cell followed by a vertical series of superposed cells bearing externally fertile and sterile appendages in three vertical rows; the anterior cell producing one or more stalked perithecia and numerous fertile appendages arising from small cells separated from it distally. Perithecia symmetrical with four ascogenic cells. Fertile appendages consisting of a single series of superposed cells, bearing on one side three vertical rows of flask-shaped antheridial cells. Spores once-septate.

This genus is nearly related to Stigmatomyces, through the structure of its peculiar appendages, which are very similar, except for the presence of three instead of one row of antheridial cells. Viewed laterally (fig. 18), it is not possible to determine the number of rows; but a face view, such as is shown in fig. 19, shows the slender necks of the three antheridial cells projecting side by side at regular intervals. The sterile appendages (fig. 20) consist also of a series of superposed cells, each producing a single sterile lateral branch.

The receptacle is somewhat complicated in structure, consisting of four cells arranged as above described, the peculiarly differentiated posterior series of superposed cells, which bear the appendages externally, recalling, in a way, the primary appendage of Ceratomyces. The cell which produces the perithecia becomes distally divided, usually on one side only, the cells thus formed producing the second set of appendages, which, in well developed specimens, may be very numerous and extend almost completely around the base of the stalk-cell of the perithecium on both sides. Fresh material for a more minute examination of this genus is greatly to be desired, since the specimens of the single species which constitute the types are in very poor condition, with the exception of the one from which fig. 17 was derived.

Idiomyces Peyritschii Thaxter. Plate IX, figs. 16–21.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 162.

More or less tinged with yellowish or amber brown. Receptacle consisting of two superposed basal cells, surmounted by two cells; the outer, having a very thick external wall which forms a distinct prominence distally, is succeeded by a row of about five or six superposed, more or less flattened cells, extending beyond the base of the stalk-cell of the perithecium, which bear externally three vertical series of closely-set appendages: the inner is succeeded by a single rounded cell followed by several small cells, which give rise to a series of similar appendages variable in number. Appendages mostly fertile, borne on one or two squarish basal cells, terminated by a simple or once branched short sterile filament. Perithecia short, thick, subconical, the apex sub-truncate, the base inflated, borne on a long stalk made up of a single basal and two sub-basal cells, the outer directly in contact with the perithecium, the inner separated from it by two small cells. Spores, $60 \times 4\,\mu$. Perithecia, $110–130 \times 60–70\,\mu$. Appendages longer, $80\,\mu$. Receptacle, $130–165 \times 70–95\,\mu$. Stalk of perithecium, longest, $200\,\mu$.

On *Deleaster dichrous* Grav., Germany.

The types of this species were found on the upper surface of the abdomen of its curious host, among specimens of the latter contained in the Museum collection at Cambridge. The dozen types obtained show a considerable variation in the number and position of the appendages at the base of the stalk-cells of the perithecium. The latter appear to arise always from the same cell, whether the individual produces one perithecium or more than one. In a single instance three perithecia are developed, while a majority appear to have two. The few specimens accessible of the only American Deleaster were examined carefully, in the hopes of finding a similar parasite, but without success.

CORETHROMYCES Thaxter. Plate IX, figs. 1–6.

Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 36, and XXVIII, p. 180.

Receptacle consisting of several superposed cells, the sub-basal cell and rarely also the cell above it producing a stalked perithecium, the terminal cells giving rise to several branched appendages. Antheridial cells superposed to form an obliquely septate branchlet with projecting necks. Perithecium symmetrical or nearly so, the stalk-cell well developed; its cell-rows of four cells each. Spores once-septate. Trichogyne filamentous, simple or branched.

The material on which the original description of this genus is based was so insufficient that it has been necessary essentially to modify the present diagnosis in the light of more abundant data subsequently obtained. It approaches Rhadinomyces more closely than any other genus, especially in the character of its antheridia, and may eventually have to be united with it. In all three species, however, a cell is present above the sub-basal cell of the receptacle, which is either sterile or produces a second perithecium, while in Rhadinomyces the secondary perithecia, which are very commonly developed, arise invariably from the sub-basal cell of the receptacle. There are other differences in general habit, character of the appendages, and details of structure in the antheridial branchlets, which, though of less importance, all tend to make it seem advisable to keep these genera distinct until further data concerning them can be obtained.

In development the spore first divides into five superposed cells. The terminal one by successive proliferation from one side, produces a tuft of terminal branches and branchlets, which are often broken or obsolete in older individuals. The sub-basal cell produces a single perithecium, which first appears as a triangular cell cut off from its anterior upper portion, as in Laboulbenia. The cell above this either remains unchanged or produces a second perithecium, while the sub-terminal cell gives rise to the main appendages. The antheridia arise as branchlets from the main appendages, the terminal cells of which are sterile. The trichogyne is well developed, slender, septate, and more or less branched.

The three species are found on beetles belonging to the Staphylinidiæ, and inhabiting very wet situations, especially along the margins of streams or ponds.

Corethromyces Cryptobii Thaxter. Plate VII, figs. 1–2.

Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 36, and XXVIII, p. 181.

Perithecium usually very long and slender, becoming uniformly suffused with brown; straight, slightly inflated toward its base, tapering very gradually to its blunt symmetrical apex;

its stalk-cell hyaline, blackened at its base, two or three times as long as broad, its basal cells not abruptly distinguished, and concolorous with it; the inner as long as the stalk-cell. Receptacle short, narrowed below, the basal cell small, hyaline or brown and translucent, the rest black, opaque. Terminal appendages short, usually broken or obsolete, the main (lateral) appendages primarily two in number: an upper simple, a lower furcate near its base, each consisting of a main more or less obliquely septate axis, from which numerous obliquely septate more or less appressed branches are produced externally, which may themselves produce simple branchlets; the branches externally opaque. Spores, $40 \times 4\ \mu$. Perithecia, including basal cells, 415×50–$130 \times 33\ \mu$. Average, $290\ \mu$ long; the stalk-cell, 37–95 μ long. Appendages, 130–536 μ long. Total length to tip of perithecium, 600–200 μ.

On *Cryptobium pallipes* Grav., and *C. bicolor* Grav., Virginia, Pennsylvania, Kansas.

The type of this fine species was found on the leg of a specimen of *C. pallipes* sent me from Virginia by Mr. Pergande, and a small number of examples was subsequently found on a specimen of *C. bicolor* in the Museum collection. More recently a large number of both these hosts, sent me from Kansas by Mr. M. A. Barber, have yielded abundant material, and it is much to be regretted that the figures given on Plate IX. should not have been drawn from these perfect and well developed specimens. The species varies very greatly in size, as may be inferred from the above measurements, as well as in the relative length of its different parts. In perfectly developed specimens the appendages often slightly exceed the tip of the perithecium. There is a good deal of variation in the number and length of the branchlets, more than one commonly arising from each cell of the main axis, which, though straight and rigid, appear to be formed as a result of successive sympodial branching. Specimens occurring on the abdomen of the host are commonly far larger than those which are attached to the legs. In general appearance the species recalls in some respects the remarkable East Indian *Laboulbenia palmella* (Plate XVIII, fig. 11), but the resemblance is wholly superficial. The hosts above mentioned are large and conspicuous Staphylinid beetles, common under stones and in wet rubbish along the margins of streams and ponds.

Corethromyces jacobinus Thaxter. Plate IX, figs. 3–5.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 181.

Perithecium hyaline, becoming faintly brownish, rather short, somewhat inflated, tapering to a blunt apex. Receptacle short, the basal cell small, hyaline; partly, sometimes wholly, black and opaque. Appendages arising in a fan-like tuft, the two or three main axes usually short, formed by sympodial branching; the branchlets once or twice branched, much longer, the outer becoming brown, the inner mostly hyaline. Perithecia, 65–$75 \times 22\ \mu$. Appendages about 160–200 μ long. Total length to tip of perithecium about 150 μ.

On *Lathrobium jacobinum* Lec., California; on *L. collare* Er., Kittery Point, Maine; on *Lathrobium* sp., Arlington, Mass.

This small species varies very greatly in luxuriance; figures 3 and 4 representing more or less extreme cases, between which every degree of development may be seen. In a few instances two perithecia are formed, one above the other, as already described. The form, though so

widely distributed, is apparently a rare one, and abundant material is needed for its further study. The hosts on which it occurs were taken under stones and in moss at the borders of ponds.

CORETHROMYCES SETIGERUS Thaxter. Plate IX, fig. 6.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 181.

Perithecium becoming tinged with brown, slightly inflated and tapering to the blunt apex; stalk-cell hyaline, long. Appendages arising from the distal and sub-distal cells of the receptacle, consisting of two or three rounded basal cells, which bear numerous long, straight, cylindrical, septate, deep brown branches, some of them once branched, the whole curved slightly outward and forming a crest-like structure. Basal cell of receptacle hyaline, the rest, including the two appendage-bearing cells, strongly blackened externally. Perithecia, $110 \times 35\,\mu$. Spores (measured in perithecium), $30 \times 4\,\mu$. Total length of appendages, $200\,\mu$ or more. Two basal cells of receptacle, $35 \times 15\,\mu$. Total length from base to tip of perithecium, $200–220\,\mu$.

On thorax of *Lathrobium nitidulum* Lec., Massachusetts; on *L. tenue* Lec., Michigan.

This species is closely allied to the preceding, yet seems sufficiently well marked to keep distinct. Its appendages are quite characteristic, recalling those of *Laboulbenia cristata*. The main axes seem almost obsolete, being reduced to several rounded cells, which form a group, from which arise the long, rigid, brown branches. The stalk-cells and lower basal cells of the perithecium are much larger than in *C. jacobinus*, as is the perithecium itself. The material examined was all obtained from specimens in the Museum at Cambridge, and is not in very good condition.

RHADINOMYCES Thaxter. Plate IX, figs. 7–15.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 179.

Receptacle consisting of two superposed cells, from the upper of which arise one to several stalked perithecia and a main appendage; the appendage consisting of three superposed cells, the upper bearing terminally a series of simple sterile branches, the two lower producing from their distal ends short antheridial branches or long sterile branches or both. Antheridial cells flask-shaped, superposed in short series. Perithecia borne on a single stalk cell followed by four basal cells; its wall-cells four in each series. Spores once-septate. Trichogyne filamentous, simple or branched. Ascogenic cells, four.

In some instances the sub-basal cell of the receptacle may produce one or more antheridial branchlets directly, in addition to those on the main appendage. The antheridial cells are sometimes single, more often superposed in threes, the upper one being free and terminal. A few specimens have been observed in which the antheridial branchlets, instead of being borne directly from the primary appendage, as in fig. 12, arise from some of its ordinarily sterile branches.

The ascogenic cells are readily made out in the paler species, and at maturity four may be usually distinguished; but this number does not seem to be constant even in the same species. In a few instances a peculiar spine, present also in other genera, has been observed near

the base of the primary sterile branch (fig. 22) in *R. cristatus;* but its significance is undetermined.

As has been previously mentioned, it may eventually prove necessary to unite this genus with Corethromyces.

RHADINOMYCES PALLIDUS. Plate IX, figs. 7–9.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 180.

Hyaline or slightly yellowish. Perithecium becoming pale amber brown, except the tip, which is colorless; more or less inflated, conical above, the apex blunt symmetrical, the stalk-cell about as long as the receptacle. Receptacle small, the basal cell somewhat larger than the sub-basal. Appendage of three nearly equal cells, the distal bearing terminally from one to three sterile, simple, tapering flexuous branches; the other two producing distally groups of antheridial branchlets arising from small cells cut off from their upper inner angles. Spores, $45 \times 3.7\,\mu$. Perithecia, $86 \times 33\,\mu$. Primary appendage about $60\,\mu$, its longer branches 225–$375\,\mu$. Total length to tip of perithecium, average $200\,\mu$.

On *Lathrobium punctulatum* Lec., and *L. angulare* Lec., vicinity of Cambridge, Mass., and Kittery Point, Maine.

Var. a. Plate IX, fig. 10–11. Larger than the type, the perithecia proportionately narrower, becoming evenly suffused with amber yellow. Appendage often relatively shorter with numerous sterile branches arising from all its cells, often crowded, and usually producing short antheridial branchlets. Perithecia, larger, $165 \times 45\,\mu$. Spores, $44 \times 4\,\mu$. Appendage, 37–$150\,\mu$; its longest branches about $300\,\mu$. Total length to tip of perithecium (larger), $425\,\mu$.

Occurring with the type on *L. punctulatum* Lec.; on *L. fulvipenne* Grav., Germany.

As a matter of convenience I have separated from the type, which is on the whole moderately constant, a series of larger forms often occurring with it and approaching *L. cristatus* in some respects. While in the type the size is small, the perithecia pale amber brown with hyaline tips at maturity, the branches of the appendage few in number, with the antheridia borne in the typical fashion directly from the main appendage; in the variety very considerable differences in size and general habit are noticeable. While in the type two perithecia are unusual, in the variety there are sometimes five, uniformly tinged with amber yellow; the appendage is apt to be much more copiously branched, and though this is not always the case, it is often decidedly shortened, with a corresponding increase in the luxuriance of its branches. In the European specimens the appendage is more normal in form and much like that of *R. cristatus*, which in the end may prove a mere variety. It is also distinctly larger even than the ordinary American forms of the variety, but cannot be separated specifically.

RHADINOMYCES CRISTATUS Thaxter. Plate IX, figs. 12–15, 22–23.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 180.

Perithecia one to four, hyaline, becoming yellowish or pale brownish, the stalk-cell as long as or considerably longer than the perithecium proper. Appendage large, the terminal cell bearing distally a series of from two to six (usually four) long, stiff, cylindrical, septate, dark red brown

simple branches, arising side by side antero-posteriorly; the middle cell usually bears a single similar sterile branch arising from a small cell cut off from its upper inner angle, and also sometimes producing an antheridial branchlet; the basal cell has two cells similarly cut off from its distal end on either side, each producing antheridial branchlets. Spores, 50 × 4 μ. Perithecia, 125–140 × 30 μ; the stalk-cell, 75–170 μ. Main appendage, 110–185 × 18 μ; its longest branches, 750 μ.

On *Lathrobium nitidulum* Lec., and *L. punctulatum* Lec., Cambridge, Mass., and Kittery Point, Maine.

This striking form does not appear to vary to any great extent even on the two hosts above mentioned, and well developed specimens correspond closely to the type figured on Plate IX (fig. 12). The long, brown, rigid branches of its appendages are perhaps the most striking apparent difference which distinguishes it from *R. pallidus*; but although with only the type of *R. pallidus* before him (figs. 7–8), one would hardly hesitate in separating the two species, the European material and some of the varietal forms of this species render it not altogether certain that the present form is distinct. The fact, however, that *R. pallidus* occurs on the same host (*L. punctulatum*) in the same position and in its typical form, and that no tendency to variation toward *R. pallidus* is visible in the abundant material of *R. cristatus*, derived from several specimens of this host on which it was found at Kittery, indicates that at least these differences are not variations due to the position of growth or the character of the host.

The hosts affected were collected in considerable numbers about wet bogs or beside ponds; but the species seem very rare.

RHIZOMYCES nov. gen. Plates III–IV.

Receptacle consisting of two cells, the lower with rhizoid-like outgrowths from its base which penetrate the body cavity of the host. Perithecia solitary, borne on a stalk-cell arising from the sub-basal cell. Antheridial appendages consisting of numerous superposed cells all of which, except the lowest, produce externally antheridial branches, their basal cells bearing simple antheridia of the usual flask-shaped type.

This genus is clearly distinguished from all others by the structure of its strikingly peculiar appendage. The antheridia, however, are exactly like those of Laboulbenia, although the appendage in other respects differs fundamentally from that which is found in the genus just mentioned. It seems only remotely allied to any of the known genera, and is unique in that it produces from its basal cell well developed, semi-filamentous branching rhizoids (Plate IV, fig. 3), which penetrate the body cavity of the host, the softer chitinous integument of which it inhabits. The main axis of the appendage appears to result from successive sympodial branching, each cell representing the base of a sympodial branch, on which the corresponding antheridial branch was at first terminal. From the fact that the types are all mature individuals, the early stages of development were not seen; yet it seems improbable that they present any great peculiarities, unless perhaps as regards the trichogyne. In the type species the position of the ascogenic cells, of which there are two lying side by side in the mature perithecium, is unusual, the long axis being turned at a considerable angle to that of the perithecium, instead of coincid-

ing with it, as is usually the case; so that all the younger asci are seen pointing outward and downward (Plate III, fig. 3). The spores are unusually minute in proportion to the size of the perithecium, and it is possible that the asci may be eight-spored. Seen within the perithecium, however, they seem to be four-spored.

Rhizomyces ctenophorus nov. sp. Plate III, fig. 3; Plate IV, figs. 1–4.

Perithecium, including its basal cells, dark amber brown, asymmetrical, the lower half somewhat inflated, the rather truncate tip not distinguished from the tapering, neck-like, slightly bent upper half; the sub-terminal wall-cells marked by fine transverse striations; the lower half not distinguished from the basal cells, which are themselves abruptly distinguished from the long, slender, cylindrical stalk-cell. The basal cell of the receptacle rounded below, about half as large as the sub-basal, the rhizoids rather copiously and irregularly branched or lobed, colorless. Appendage shorter than the stalk-cell of the perithecium; the axis simple or exceptionally furcate near the base, consisting usually of about thirteen superposed cells; the basal cell small, blackened and somewhat constricted; the rest producing antheridial branches always on the same side, forming a unilateral series; the branches in turn several times more or less sympodially branched; the branchlets distally somewhat indurated and suffused with blackish brown, the whole forming a comb-like tuft; the ultimate branchlets curved outward and downward. Antheridia long, flask-shaped, sessile, borne rather irregularly, one to four together, from the upper surface of the basal cell of the antheridial branch; sometimes also from the sub-basal cell. Spores, $25 \times 3\,\mu$. Perithecium, including basal cells, $180–200 \times 62–70\,\mu$; smallest, $120 \times 35\,\mu$; the stalk-cell, $275–620 \times 35\,\mu$; average, $550\,\mu$ long. Appendage, longer, $325–340\,\mu$; greatest diameter of axis, $17\,\mu$; antheridial branches, longer, $45–50\,\mu$. Receptacle, $60 \times 45\,\mu$. Rhizoids, longer, $86 \times 13\,\mu$. Total length to tip of perithecium, longer, 800–880.

On *Diopsis thoracica* Westw., Coffee Hill, Liberia (O. F. Cooke) and Zanzibar.

This fine species was found growing in a tuft on the soft chitin of the lower surface of the abdomen of its peculiar host, and although it is difficult to detach the plant without breaking its rhizoids, a few specimens were obtained which show them little injured, and with portions of the host's integument still adherent about the constriction which separates them from the basal cell of the receptacle. The appendage is among the most striking in the group, and from the flat, uniseriate arrangement of the sterile branchlets from the antheridial branches, bears a certain resemblance to a large comb or series of small combs. The branches which arise at or near the extremity of the appendage are usually wholly sterile, and in the fertile ones there is little regularity in the number of antheridia. The striation of the sub-terminal wall-cells of the perithecium seems to be a constant and peculiar character; but is not so conspicuous that it might not be readily overlooked.

LABOULBENIA Montagne and Robin (1853). Plates I–IV, XIII–XXII.

Receptacle consisting typically of seven cells, exclusive of three small cells which form the base of the perithecium; the two lower (cells I and II) superposed and forming the receptacle proper; the cells above them arranged in an anterior and posterior series, the latter consisting

of two cells, a lower (cell II) and an upper (cell IV), the inner upper portion of which is separated as a third cell (cell V, which is in reality made up of two cells placed side by side), the former consisting of a lower (cell VI) and an upper (cell VII) obliquely superposed. Appendages arising from a blackened insertion cell above cells IV and V (exceptionally from a variable number of subdivisions of these cells, in which case the black insertion cell is wanting). Perithecium solitary, compressed, asymmetrical or nearly symmetrical, rarely appendiculate, sessile or stalked, having four wall-cells in each longitudinal row. Appendages sometimes numerous, but typically consisting of two basal cells, from the outer of which arises one, from the inner two branches or series of branches, the inner fertile bearing the flask-shaped antheridia, singly or more or less irregularly grouped. Ascogenic cells two, lateral. Asci four-spored. Spores once septate. Trichogyne filamentous, simple or branched.

Owing to the occurrence of several exceptional modifications in the structure of certain members of this genus, it is very difficult to characterize it briefly and concisely; and owing to the fact that it contains nearly half of all the members of the family, its variations are, as might be expected, very considerable. The more striking departures from what may be considered the type form, are illustrated by the following species: *L. Gyrinidarum*, *L. Guerinii*, *L. Orectogyri*, *L. Oberthuri*, *L. variabilis*, *L. brachiata*, *L. fasciculata*, and to a less extent by *L. proliferans* (Plates XXI and XXII), in all of which the usual black insertion cell is absent or modified, while cells IV and V have undergone division above into a series of cells differently arranged in different cases, all of which may give rise to appendages. A further abnormal septation of these two cells of a somewhat different character is seen in *L. Clivinæ* (Plate XXI, figs. 16–17), a species otherwise peculiar for the coalescence of its appendages at the base. Typically the black insertion cell bears above it two cells, an outer forming the base of a single simple or branched sterile appendage; the inner giving rise on either side to a branch which is fertile and may be variously divided. The complications of this simple type are, however, numerous and often very striking, resulting either from the sub-division of one or of both of these basal cells, and the production from them of more numerous branches; or from a combination of both these modifications. Such variations are well illustrated by species like *L. Brachini*, *L. luxurians*, *L. minima*, *L. zanzibarina* or *L. Galeritæ*.

A second departure from the type form is illustrated by such species as *L. Kunkeli*, *L. longicollis*, *L. Galeritæ* and their allies (Plates XVIII and XIX), in which the lower cells in each of the four series of wall-cells of the perithecium become greatly elongated, forming a well defined stalk on which the latter appears to be borne.

The perithecium is also subject to considerable variation in form, especially as regards the modifications of its lip-cells. In two cases the latter are appendiculate (*L. Gyrinidarum* and *L. cornuta*); while in others they are curiously expanded (*L. umbonata*, *L. texana*, etc.) or irregular. The four rows of wall cells may sometimes show a distinct spiral twist, as in *L. arcuata*, *L. decipiens* (Plates XVIII and XX) and a few other forms, and are composed of four cells each; although, except in younger specimens, the usual blackening below the pore obscures the upper septa.

The trichogyne, although it is sometimes merely a simple, sparingly septate filament, is more commonly, often very copiously branched, the receptive tips being either straight (Plate II, fig. 3), or in many instances spirally twisted (Plate XXI, fig. 15). The antheridia are generally very

uniform, but vary greatly in their numbers, being sometimes solitary or nearly so, as in *Laboulbenia Pachytelis*, or produced in great numbers, as in *L. Brachini* and several others. Their arrangement on the antheridial branchlets may be characteristic; for while as a rule they are apt to be solitary, in species like *L. variabilis* (Plate XXI, fig. 3), or *L. proliferans* (Plate XVII, fig. 23), they are more or less definitely grouped.

The homologies of the "receptacle" are evidently such as have been previously described (p. 206), the cells above cell II (Plate II. fig. 5) representing the union of the stalk-cells of the perithecium (cells VI and VII; *h* and *p* of the figure), with the base of the appendage (cells III to V), the latter (cell V) being, as may be seen when they have been separated by potash, in reality a pair of cells placed side by side and appearing like one. The bodies spoken of as the "appendages" in this genus are therefore morphologically only the branches of a main appendage.

With the few exceptions above mentioned, the type structure of the individuals which compose the genus is remarkably constant and very clearly defined; so that little difficulty will be experienced in distinguishing it from all others. Its immediate connections with other genera are not, however, clear, and its nearest ally is difficult to designate.

The aquatic forms already enumerated might perhaps be separated in a genus by themselves, were it not for the fact that their chief peculiarity, namely, the origin of their appendages, is almost exactly paralleled by *L. variabilis*, which can by no possibility be excluded from Laboulbenia. Unless other more important points of difference should appear, it is impossible thus to separate them. It may, however, be remarked in passing that *L. Gyrinidarum* is one of the very few species in which the character of the antheridia has not yet been satisfactorily made out, although the trichogyne is highly developed.

In the following descriptions the black cell from which the appendages arise is spoken of as the "insertion-cell," the cells of the receptacle being numbered (I to VI), as in fig. 5, Plate II, and the side bearing the perithecium is considered anterior. The species are sometimes cosmopolitan, and are very numerous and varied, inhabiting a great variety of hosts, including Coleoptera, Diptera, Neuroptera and the Acarini. Many of the forms of what I have called the "*flagellata*" type are very variable, and given species may inhabit hosts of many species and even genera. Specific determinations are thus often difficult, and in the group of species represented by *L. flagellata*, *L. anceps*, *L. elongata*, *L. Peterostichi*, *L. polyphaga*, there is much uncertainty in regard to the identities of many of the varieties. The synonymy in these cases is also confused, and some names may have to be discarded.

Laboulbenia Rougetii Mont. et Robin.

Robin, Hist. Nat. d. Veg. Par. p. 622, Plate X, fig. 2; Montagne, Sylloge Cryptog. p. 250; Peyritsch Sitz. d. Wien. Acad. Vol. LXVIII, p. 247; Sorokin, Veg. Par. of Man and Anim. as a Cause of Contagious Diseases, Vol. II, p. 412, Plate XXXIII, fig. 781; Winter, Die Pilze Deutsch. II. p. 921; Berlese Malpighia, Vol. III, p. 54; also in Saccardo, Sylloge Fung. Vol. VIII, p. 911; Thaxter, Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 12. See also Rouget, Production Paras., etc. in Ann. d. l. Soc. Entomol. d. France, 1850, T. VIII, p. 21, Plate I, figs. 1–7.

"Dark yellow-brown; Paraphyses inserted on a broad base, irregularly dichotomous, about as long as the perithecium, yellow; stalk much shorter than the perithecium."

On *Brachinus crepitans* L., *B. scolopeta* F., *B. explodens* Duft., Europe.

The above description is quoted from Peyritsch (l. c.), although it is quite useless for purposes of identification. The figures given by Robin appear at first sight to be good, and to furnish a means of identifying the species; but some of them are almost certainly incorrect in their anatomical details, and it is doubtful whether any of them are to be depended upon, either as exact reproductions of the originals or as exhibiting the essential characters of the species. I have examined specimens of a Laboulbenia from *B. explodens*, taken in Germany, but in all cases they correspond to the rather well marked type which I have called *L. europæa* (Plate XVI, fig. 15), a form which is known to occur on several other hosts.

In a previous paper (l. c.) I have doubtfully referred to this species a form found growing densely crowded on the legs of *Platynus cincticollis* in this country; but a comparison of almost unlimited material of the various forms which I have placed together under *L. elongata* makes it clear that our form cannot be considered to be the species of Robin, unless, perhaps, the whole "*flagellata*" series should be united under his name. Whether *L. Rougetii*, which is unfortunately the type of the genus, is really distinct from either *L. elongata*, *L. flagellata*, *L. anceps*, or *L. europæa* must remain uncertain until sufficient material of the European forms on *Brachinus* has been examined to make clear what is really intended by Robin's name. It should be mentioned, however, that I have never seen a specimen of *L. flagellata* on any of the very numerous specimens of American Brachinus examined, even from situations where species of Platynus infested by *L. elongata* were common. The forms of *L. Brachini* (Plate XX, fig. 2), which at first sight seem identical with some of the varieties of *L. elongata*, cannot be confused, on careful comparison, either with this species or with *L. Europæa*.

A few old specimens of *L. europæa* in my possession, from European material of Brachinus, in which the appendages have been broken and have produced a few abnormal branches at the base, bear, it must be admitted, a distinct resemblance to the dark brown figure of Robin's Plate X.

Laboulbenia europæa Thaxter. Plate XVI, figs. 15–17.

Amber-brown. Perithecium darker amber-colored, rather narrow, but sometimes inflated, its tip nearly straight, broad, black except the edges of the coarse lips, which are turned slightly outward, an olive shade extending below the blackened portion. Outer appendage hyaline, suffused below with olive-brown, deeply colored externally near the base, simple or more commonly consisting of a basal and a sub-basal cell which bears two long slender tapering branches; more rarely the basal cell bears two branches directly, the inner simple, the outer bearing two branches from its basal cell. Inner appendage consisting of a basal cell which may bear two branches directly, or more commonly is followed by a sub-basal cell bearing a long, simple, sterile branch and a shorter fertile branch, producing several antheridia and one or two sterile divisions, which sometimes become elongate. Receptacle normal, a very slight olive suffusion on the external surface of cell IV. Spores, 55–59 × 4–4.5 μ. Perithecia, 130–140 × 55 μ. Appendages (longest), 250 μ. Total length to tip of perithecium, 250–300 μ.

On *Chlænius æneocephalus* Dej., *C. chrysocephalus* Rossi, *Callistus lunatus* Fabr., *Aptinus mutilatus* Fabr., *Brachinus explodens* Duft., Europe.

This species, although occurring on such a variety of hosts, is very constant in its essential characters, and appears to be undoubtedly distinct from *L. flagellata* and its near allies. Its general color, the shape of its perithecium, the olive coloration at the base of its outer appendage, and the blackened external branch of the latter, serve to distinguish it readily. It is allied to *L. flagellata* and *L. Pterostichi*, and as already mentioned, may eventually prove to be the form intended by Robin as the type of his *L. Rougetii*, although the data available for distinguishing this species would hardly lead one to unite the two. The specimens examined are from Greece and Central Europe.

Laboulbenia elongata Thaxter. Plate I, figs. 32–39; Plate II, figs. 5, 7, 8, 13–18; Plate XVI, figs. 1–14.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 10; *L. gigantea* Istvánffi, Termész. Füzet. Vol. XVIII, 1895, p. 82, Plate II.

Perithecium nearly colorless or straw yellow to almost black-brown, blackened below the apex, hyaline about the pore, more or less evenly inflated, the rather small lip-cells turned slightly outward. Appendages very variable in form, size, and color; hyaline or yellowish to deep red brown, arising from an inner and an outer basal cell; the outer bearing a single branch, rarely simple, usually once or twice branched; the inner producing two branches on either side, rarely simple, often many times successively branched forming a dense tuft; the branches rigid and distally attenuated, or flexuous, with bluntly rounded tips, slender or stout, rather closely septate. Antheridia solitary, or borne in pairs laterally or terminally, on sometimes densely crowded branchlets. Receptacle short and rather stout, or very elongate; normal in form, hyaline or distally suffused with brown. Spores, 60–100 × 5–8 μ. Perithecia, 110–240 × 35–95 μ. Longest appendages, 180–750 μ. Total length to tip of perithecium, 300–800 μ (1200 μ *sec.* Istvánffi).

On *Platynus cincticollis* Say, *P. extensicollis* Say, *P. melanarius* Dej., *P. ruficornis* Lec., *P. picticornis* Newm., *P. bicolor* Lec., *P. Pusillus* Lec., *P. dissectus* Lec., *P. brunneomarginatus* Mann., *P. floridanus* Lec., *P. ovipennis* Mann., *P. sinuatus* Dej., *Anisodactylus baltimorensis* Say, Maine to Florida and California. On *Colpodes purpuripennis* Chaud., *C. cæruleomarginatus* Chaud., *C. duplex* Bates, *C. grata* Bates, *C. petilus* But., *C. incultus* Bates, *C. sphodroides* Chaud., *C. cyanonotus* Chaud., *C. tenuicornis* Chaud., Mexico and Central America. On *Platynus* (?) sp., Japan. On *Limosthenes* (*Pristonychus*) *cavicola* Sch., *Platynus ruficornis* Goeze, Europe. On *Macrochilus biguttatus* Goeze, Liberia, Africa.

In this species I have included a large series of specimens from various parts of the world which, though varying very greatly in form and size, appear to be identical, since every imaginable gradation exists between the more extreme types. The figures of *L. flagellata*, given by Peyritsch, which it most nearly resembles, are so bad that, without a knowledge of the host, it would be impossible to determine the species with any certainty. His fig. 2, for example, if correctly drawn, would belong to a quite different type, and his fig. 6 is undoubtedly the young condition of very different and undescribed form. It may be noted further that although Bembidia occur abundantly associated with the species of Platynus, on which the present species is parasitic, I have never found a specimen on the former host. Whether it should not be united with *L. anceps* is another question which only the examination of European material can determine, as

it is not clear from Peyritsch's account in what respects this species differs from *L. flagellata*. The only peculiarity of the former species appears to be that cell III is unusually elongated; yet this may have been accidental or due to careless reproduction. That the typical *elongata* occurs in Europe on Platynus (Anchomenus) as well as on *Pristonychus cavicola* is an undoubted fact, the *L. gigantea* of Istvánffi being identical with the most typical forms of *elongata*, and the material which I have seen derived from species of Platynus taken in the neighborhood of Vienna, seems also not separable from the same form. The retention of the species as distinct from *L. flagellata* and *L. anceps* is therefore provisional, and it may prove that all three are the same.

The variations of *L. elongata*, which are very numerous and are in part represented on Plate XVI, appear to be due in part to the character of the individual host attacked and partly to the position in which the plant grows; this species illustrating better than any other the variations which have been previously alluded to (p. 240) as dependent on these circumstances. In brief, the species may be very elongate (more than a millimetre in length from the foot to the apex of the perithecium) or very short (300 μ or even less) and stout; in color it may vary from pale straw color to deep brown, specimens sometimes occurring that are nearly opaque; the appendages may be short and stout or very long and slender, sometimes almost simple, in other cases very densely branched, hyaline or opaque, yet conditions showing every gradation between these extremes are so numerous as to render the separation even of varieties impossible.

One of the short stout varieties that occurs on the legs of *Platynus cincticollis* was formerly thought by me to be a form of *L. Rougetii*, but it seems certain that this variation is merely due to the position of growth, since it occurs also on the jaws of the host as well as when the parasite grows crowded at the tips of the elytra. The type-form is that which grows as a rule near the base of the legs on the inferior surface of the thorax, and is represented in fig. 4, Plate XVI. It is one of the commonest of all the species as well as the most widely distributed, and it is to be hoped that its great variability will not lead to an extended synonomy in the future.

LABOULBENIA FLAGELLATA Peyritsch.

Peyritsch Sitz. d. Wien. Acad. LXVIII, p. 247, Plate I, figs 1–3; Sorokin Veg. Paras. Vol II, p. 415, Plate XXXII, fig. 765; Winter's Pilze Deutsch. II, p. 921; Berlese, Malpighia, III, p. 55; also in Saccardo Sylloge Fung. Vol. VIII. p. 910.

"Light yellowish brown, only the mamilla of the perithecium blackish about its base; pseudoparaphyses few in number (4–7), about equal, simple or divided at the base, colorless, for the most part exceeding the perithecium in length."

On *Bembidium lunatum* Duft., *Anchomenus albipes* F., *A. marginatus* L.

The above description is taken from Peyritsch, but is quite inadequate as a means of determining the species: which, as has been previously mentioned, may have to be united with *L. elongata*. I have never in my own experience seen any species like it on members of the genus Bembidium.

Laboulbenia anceps Peyritsch.

Sitz. der Wien. Acad. LXVIII, p. 247, Plate I, fig. 7; Sorokin, l. c. p. 416, fig. 758; Winter, l. c. p. 922; Berlese, l. c. p. 56; Saccardo, l. c. p. 911; Thaxter, l. c. Vol. XXVIII, p. 176.

"Light yellowish brown; pseudoparaphyses in small numbers, bent, about as long as the perithecium and colorless."

On the legs of *Anchomenus viduus* Pz., vicinity of Vienna, Austria.

As in the previous instance, this species cannot be determined from published data. It seems peculiar from the elongation of cell III, but is otherwise without characters which would distinguish it. It may have to be ultimately united with one or both of the preceding species.

Laboulbenia paupercula Thaxter. Plate XIII, figs. 24–27; Plate I, fig. 9.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 269.

Becoming more or less deeply suffused with olive brown. Perithecium often irregularly bent, its lip cells prominently distinguished, distally nearly truncate. Appendages arising side by side in a plane at right angles to the usual position, so that there appears to be but one appendage, the larger (outer) usually once branched above its sub-basal cell, the smaller (inner) consisting of a small basal cell bearing usually two short branches more commonly simple, and bearing small groups of antheridia. Receptacle rather small; hyaline, becoming more or less deeply suffused with brown, except the lower part of the rather large basal cell; cell V twisted out of its normal position and only visible on one side, as a rule. Spores, $45 \times 4.5\,\mu$. Perithecia, $100–120 \times 40\,\mu$. Appendages, longest, $250–350\,\mu$. Total length to tip of perithecium, $160–222\,\mu$.

On *Platynus extensicollis* Say, *P. ruficornis* Lec., *P. melanarius* Dej., and *Platynus spp. indet.*, Maine to Virginia.

This small species appears to be constant in its characters, and is at once separable by the twist which involves the basal and insertion cells of the appendages as well as cells (IV) and (V) of the receptacle, and which would lead one to suppose, at first sight, that the plant had but one appendage, as was stated in the original description. It usually occurs on the thorax of its hosts and on the adjacent bases of the elytra.

Laboulbenia rigida Thaxter. Plate XV, figs. 16–17.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 475.

More or less deeply tinged with olive brown. Perithecium becoming almost or quite opaque, somewhat inflated, a slight depression at its base above the more or less bulging terminal portion of the receptacle, its apex stout, snout-like, bent slightly inward. Appendages arising from two basal cells, the outer of which gives rise to a single simple or rarely once branched rigid branch, tapering slightly or nearly cylindrical; the inner producing two similar somewhat shorter branches almost invariably simple, and bearing near the base solitary sessile antheridia. Recep-

tacle normal, sometimes rather elongate. Spores, 75 × 55 μ. Perithecia, 125–150 × 10 μ. Appendages (longest), 300 μ. Receptacle, 185–300 μ. Total length to tip of perithecium (largest), 300 μ.

On *Pterostichus patruelis* Dej., Maine and Massachusetts.

This species may be distinguished by its rigid habit, straight single outer appendage and the blunt, snout-like apex of its perithecium. It is one of the less well marked types of the genus, yet sufficient material from the two localities mentioned indicates that its characters are sufficiently defined to warrant its specific separation from other species of the *flagellata* type.

Laboulbenia Pterostichi Thaxter. Plate XVI, figs. 18–21.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 166.

Hyaline, becoming more or less, often deeply, suffused with olive brown. Perithecium becoming deeply suffused, the outer margin commonly straight, the apex rather coarse-lipped, the lip cells hyaline about the pore, more or less blackened below. Outer appendage consisting of a large basal cell, above which it is usually two to three times successively dichotomously branched, the ultimate branches long, straight, tinged, especially the outer ones, with reddish brown, the outmost often irregularly branched. Inner appendage consisting of a small basal cell, giving rise to from one to three short branches, bearing one to several fertile branchlets, sometimes also to one or more long sterile branches. Receptacle normal, usually elongate. Spores, 75–80 × 6.5 μ. Perithecium, 130–160 × 48–55 μ. Appendages (longest), 725 μ, average, 400–500 μ.

On *Pterostichus adoxus* Say, and *P. luctuosus* Dej., Maine; *P. mancus* Lec., and *P. relictus* Newm., Southern States. On *Anisodactylus nigerrimus* Dej., vicinity of Cambridge.

This species is very closely allied to *L. elongata* and also to *L. polyphaga*, of which it may prove to be a mere variety. In some cases, especially in the variety on Anisodactylus, which is very large (about 730 μ to the tip of its perithecium), the inner appendage may be more or less copiously branched. As a rule, however, in the typical form the inner basal cell of the appendage bears two short branches often less well developed than those shown in fig 18, and bearing a variable number of branchlets which bear the antheridia terminally in pairs (fig. 20), the whole sometimes forming a short, dense tuft, as in *L. polyphaga*. The species usually grows densely crowded on all parts of the host, including the extremities of the legs, where they do not appear to vary greatly.

Laboulbenia polyphaga Thaxter. Plate XV, figs. 18–21.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 165.

Perithecium hyaline, becoming more or less deeply tinged with brown, rather narrow, the outer edge nearly straight, with a more or less well marked prominence below the apex; the tip prominent, rather narrow, bent outward, deep black, hyaline about the pore, with brown shades more or less well marked below the tip and about the lower half. Appendages two, the outer consisting of a large basal cell, which may be continued directly to form a long, simple, straight

appendage distinctly constricted at the joints, or may be more or less copiously branched. The inner basal cell bears one or two short branches, from which arise small dense clusters of brownish antheridia, and rarely a more elongate sterile branch. Receptacle rather slender, a more or less well marked brown suffusion usually present in the distal portion; sometimes wholly suffused with brown. Spores, $45 \times 4\,\mu$. Perithecia, average, $85 \times 30\,\mu$. Appendages, longest, $300\,\mu$. Total length to tip of perithecium, average, 200–220 μ.

On elytra of *Olisthopus parmatus* Say, *Stenolophus limbalis* Lec., *S. fuliginosus* Dej., *Badister maculatus* Lec. (Texas); *Harpalus pleuriticus* Kirby, *Bradycellus rupestris* Say, *Agonoderus pallipes* Fabr., Maine to Texas. A carabid near *Stenolophus*, Brazil, and *Amara* sp., Liberia, Africa.

This form, although presenting no striking peculiarities of structure, seems sufficiently well defined to warrant its separation as a distinct species. It is nearly allied to *L. Pterostichi*, and may prove a variety of this species. A form apparently identical with it occurs on several species of *Loxandrus* from Florida and Texas. The specimens on Badister are more or less evenly suffused with brownish yellow. It varies very greatly in the character of its outer appendage, which may be quite simple, as in fig. 18, or may often be rather copiously branched, resembling almost exactly the outer appendage of fig. 13 (*L. terminalis*); its ultimate branches, however, are never as long as in this species. Its antheridia are usually densely clustered in a tuft, the inner appendage only rarely producing elongated sterile branchlets. The perithecia are almost invariably blackened externally near the base, and usually bulge slightly at this point, as indicated in the figure which represents only the more simple type. The affected hosts are found in various situations, under stones or in rubbish, very often in rather dry situations. The determination of the specimens on Amara is not yet quite definite, since they vary slightly from the American form.

LABOULBENIA TERMINALIS Thaxter. Plate XV, figs. 13–15.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 475.

Perithecium deeply suffused with smoky brown, slightly inflated, the inner margin evenly curved outward, the outer more nearly straight, but bent abruptly outward to the large prominent apex, the lips of which are well defined and outwardly oblique. Appendages arising from two basal cells, a very large outer and a much smaller inner; the outer giving rise to two cells, each of which bears terminally from two to three long, slender, tapering, flexuous branches tinged, at least basally, with reddish brown; the inner bearing a single cell, as a rule followed by two terminal cells which give rise to groups of two or three rather slender sessile antheridia; insertion cell placed just below the middle of the perithecium. Receptacle pointed below, broad above, nearly hyaline or evenly tinged with brownish, cell VII slightly prominent below the perithecium. Spores, $55 \times 5.5\,\mu$. Perithecia, $120–150 \times 45–50\,\mu$. Receptacle, 200–220 μ. Total length to tips of perithecium, 275–340 μ.

On *Pterostichus luctuosus* Dej., Maine and Massachusetts.

This species occurs in tufts at the tips of the elytra or abdomen, apparently never elsewhere. It is allied to forms of *L. polyphaga* and *L. Pterostichi*, from which it is at once distinguished

by its perithecium, the broad apex of which is peculiarly flattened and bent strongly outward. It is comparatively rare, and does not appear to vary to any extent.

LABOULBENIA CONTORTA Thaxter. Plate XV, figs. 1–5.

Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 42.

More or less suffused with reddish brown. Perithecium becoming suffused with blackish brown, sometimes quite opaque; outwardly inflated, its tip turned strongly outward, the lip-cells forming a very broad and characteristic hatchet-shaped apex, its edge becoming almost vertical, the whole perithecium somewhat twisted and bent toward the appendages, its axis crossing theirs in mature individuals about at right angles. Appendages arising from two basal cells, the outer large, elongate, giving rise to a single appendage once branched or simple; the inner half as large, producing usually two simple branches, each usually producing a single pair of antheridia. Receptacle rather elongate, abruptly expanded above cell II; cells I–II forming a long, nearly cylindrical, stout stalk, rather abruptly contracted at the foot; cells IV–V elongated and twisted so that the appendages and their insertion cell are often carried across at right angles to the axis of the perithecium. Spores, 75 × 5 μ. Perithecia, 150–180 × 60–75 μ. Total length to tip of perithecium, 330–400 μ; greatest width, 90–100 μ. Appendages about 300 μ.

On *Platynus extensicollis* Say, and *P. affinis* Kirby, Maine to Virginia.

This curious species is very constant in form, and is abundantly distinct from any other species of the *flagellata* type. It is at once distinguished by the hatchet-shaped apex of its perithecium and the peculiar distortion which grows more marked in older specimens. The species is a rare one, and is found almost invariably on the inferior lateral face of the prothorax of its host, usually on the right side.

LABOULBENIA GIBBEROSA Thaxter. Plate XV, figs. 6–8.

Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 43.

More or less faintly tinged with reddish brown. Perithecium short, stout, expanding slightly from the base to a conspicuous external hunch just below its broad, almost truncate apex. Appendages arising from a large outer and a very small inner basal cell; simple or bearing two to three branches, always above the sub-basal cell, constricted at the septa, the segments becoming slightly inflated, the tips usually curved and tapering: the disk of insertion small and thick. Receptacle elongate, strongly twisted above cell II, the twist continued by cells IV and V, which are much elongated, and carry the appendages out at right angles to the axis of the perithecium. Spores, 50 × 4.5 μ. Appendages, 180 μ. Perithecia, 125 × 50 μ. Total length to tip of perithecium, 500–550 μ.

On *Platynus extensicollis*, New England.

A number of specimens of this rare and singular species show that the twisted receptacle is a constant character, which is sometimes carried to such an extreme that the ordinary direction of the appendages is reversed; the elongation and curvature of cells IV and V bending them toward the base of the receptacle. The species is large and unusually elongate, growing on the

inferior surface of its host, near the base of the middle pair of legs. Specimens from York, Maine, and the vicinity of Cambridge indicate that the species is very constant and well marked.

Laboulbenia vulgaris Peyritsch. Plate XIII, figs. 1–3.

Peyritsch, Sitz. der Wien. Acad. Vol. LXVIII, p. 248, Plate II, figs. 17–26; Sorokin, Veg. Paras. of Man, etc, Vol. II, p. 417, Plate XXXII, figs. 760, 764, 766–769; Winter, Die Pilze Deutsch. Band. II, p. 920, fig. 1, 922; Berlese, Malpighia, Vol. III, p. 56; Saccardo Sylloge, Vol. VIII, p. 912; Thaxter, Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 44.

Hyaline, becoming more or less suffused with blackish brown. Perithecium becoming blackish, usually rather narrow, its apex large and blunt, commonly bent outward. Appendages consisting of two basal cells, the outer usually much the largest; the single outer appendage usually simple, or bearing two or three usually simple branches from its second or third cell; the inner producing usually two very short branches; the insertion-cell placed opposite the middle of the perithecium. Receptacle often rather elongate, the basal and sub-basal cells forming a stalk, rather abruptly widened distally, and colorless or more or less suffused about the septum. The distal portion of the receptacle also more or less suffused. Spores, $54 \times 4\,\mu$. Perithecia, 110–150×44–$48\,\mu$. Appendage, longer, $185\,\mu$. Total length to tip of perithecium, 220–$300\,\mu$.

On *Bembidium mexicanum* Dej., *B. lævigatum* Say, and many undetermined species; Maine to Washington and Mexico; on *Trechus chalybeus* Mann., California; on *Bembidium littorale* Pz., *B. lunatum* Duft., *B. fasciolatum* Duft., *B. punctulatum* Drap., *B. obsoletum* Dej., *B. Andreæ* Sch., *B. flammulatum* Clair., *B. decorum* Pz., *B. femoratum* Sturm, *B. bipunctatum* Duft., Europe.

The species of Laboulbenia which occur on members of the genus Bembidium are in need of further study than I have been able to give them; and since they are very apt to occur in a rather imperfect condition, it is a matter of some difficulty to classify any considerable amount of material that has been obtained from this source. From my own materials I have selected this form to represent the present species; since, although it is not at all certain that it is the only one which Peyritsch included under this name, it is certainly one of the forms that he had before him in drawing his figures. It is characterized by its stout outer appendage, which may be quite simple, or may produce a small group of short, stout branches above its third cell. The two figures represent typical specimens, the one (fig. 2) from *B. mexicanum* collected in Mexico, the other from *B. lævigatum* from Kansas. Specimens in my possession from *B. Andreæ* taken in Austria, and from an undetermined species from the Province of Quebec collected by Dr. Richards, do not differ in any respect from the form which is everywhere common on various species of this beetle. Certain forms occur, nevertheless, which seem to some extent intermediate between this species and that subsequently described as *L. pedicillata*, which may also have been seen by Peyritsch and confused by him with *L. vulgaris*. That he had no very distinct idea of the distinguishing characters of his species is indicated by his assertion that he had observed it on the staphylinid beetle *Deleaster dichrous*, which is most improbable. The two species last mentioned are readily separated by the relation in position in either case between the insertion cell and the base of the perithecium, indicated in the figures, even if other more important distinctions like the character of the appendages and the form of the perithecium were not available for this purpose. The figures given in the present instance are not very satisfactory, the form of the perithecium not being well shown.

LABOULBENIA PEDICILLATA Thaxter. Plate XIII, figs. 4–8.

Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 44.

Hyaline, becoming more or less deeply suffused with brown. Perithecium inwardly inflated, often with a median external prominence; distally sub-conical, the tip somewhat pointed, nearly symmetrical. Appendages somewhat exceeding the perithecium; usually curved toward it; arising from two basal cells, the outer twice as large as the inner, giving rise to a branch on its inner upper side and followed above by a roundish cell, its lower septum blackish, from which are produced often two to five branches, which may be one to three times sub-dichotomously branched; the branches curved, often slightly circinate at the apex; the inner basal cell giving rise to a variable number of short branches, curved toward the perithecium. Basal and sub-basal cells of the receptacle forming an often very elongate stalk, abruptly distinguished from the distal portion; cells IV and V nearly equal. Spores, 50 × 3.5 μ. Perithecia, 90–95 × 36–40 μ. Appendages, 90–150 μ (longer). Total length to tip of perithecium, 180–300 μ.

On various species of *Bembidium*, Maine to Virginia, Washington.

This species, although so distinct in its typical form, approaches *L. vulgaris* in some cases, from which, as above distinguished, it seems, however, quite distinct. The production of two branches from its outer basal cell, the much lower position of its insertion-cell, its pointed perithecium, as well as the character of cells IV and V, which are nearly equal and separated by an almost vertical septum, serve to define it. It may be mentioned that although some of Peyritsch's figures of *L. vulgaris* bear a certain resemblance to this species, none of them have the character just mentioned. The species varies considerably in the luxuriance of its appendages and in the length of its stalk-cell, specimens occurring at the base of the legs being commonly the largest. It is not uncommon on various Bembidia at the margins of ponds and streams.

LABOULBENIA CASNONIÆ Thaxter. Plate XIII, figs. 22–23.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 266.

Pale olivaceous, becoming olive brown. Perithecium rather small and narrow, slightly inflated, the lip-cells prominent, bent slightly outward, the pore external. Appendages hyaline, the outer especially becoming deep olive brown externally at and toward its base; arising from a larger outer and smaller inner basal cell; the outer appendage simple, tapering, rather closely septate, constricted at its lower septa, about twice as long as the perithecium; the inner basal cell gives rise to two, perhaps more, branches, short branched and bearing single antheridia laterally. Receptacle normal, cell II large, the rest small; becoming more or less suffused with brown, the distal portion coarsely, though not very distinctly, punctate in the regions most darkly colored. Spores, 35–40 × 4 μ. Perithecia, 75 × 30 μ. Appendages, outer (larger), 170 μ. Total length to tip of perithecium, 160–200 μ.

On *Casnonia pennsylvanica* Linn., Connecticut and Tennesee.

About two dozen specimens of this somewhat insignificant, though rare, species, have been examined, and seem to be quite constant in their essential characters. Its simple outer appendage seems invariable, and although it might perhaps be confused with some of the varieties of

L. polyphaga, it seems decidedly distinct from this species as well as from any of the varieties of *L. elongata*. It occurs at the apex of the elytra of its host.

Laboulbenia Nebriæ Peyritsch. Plate XIII, figs. 19–21.

Peyritsch, Sitz. d. Wien. Acad. LXIV, p. 455, Plate II, figs. 4–8; l. c. LXVIII, p. 249, Plate III, fig. 29; Sorokin, Veg. Par. Vol. II, l. c. 417, Plate XXXII, fig. 772; Winter, Pilze Deutsch. p. 922; Berlese Malpighia, III, p. 57; Saccardo Sylloge, Vol. VIII, p. 912; Thaxter, Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 45.

Becoming suffused with blackish brown, the perithecium and distal portion of the receptacle eventually quite opaque. Perithecium short and stout; its tip bent outward, the lip-cells with hyaline margins, not very prominently distinguished; the pore external. Appendages arising from an outer and much smaller inner basal cell; the outer simple, slender, distally attenuated, rather remotely septate, somewhat rigid, becoming brown but not opaque: the inner basal cell gives rise to one or two branches, short, bearing one or two antheridia or producing one or two long sterile branches: the insertion cell above the middle of the perithecium. Receptacle normal, the basal and sub-basal cells forming a more or less, often elongate, stalk-like base, expanding rather abruptly below the terminal opaque portion of the receptacle; both becoming brownish, but not opaque, the basal cell often tapering below. Spores, $75 \times 7.5\,\mu$. Perithecia, $118–166 \times 44–66\,\mu$. Average, $55 \times 150\,\mu$. Appendages, longest, $370–550\,\mu$. Total length to tip of perithecium, $260–555\,\mu$. Average, $310 \times 92\,\mu$.

On *Nebria brunnea* Duft., and *N. Villæ* Dej., Europe. On *N. pallipes* Say, Nova Scotia to Virginia. On *N. Sahlbergi* Fisch, Washington, and *N. gregaria* Fisch, Aleutian islands.

This well-marked species was found in great abundance in the vicinity of New Haven, often almost completely covering the host with a thick fur. It is subject to considerable variation in size; but is otherwise quite constant in its essential characters, and is readily distinguished by the opacity of its perithecium and the broad distal portion of its receptacle, the distal cells of which become wholly indistinguishable; the high position of its insertion-cell, its single rigid outer appendage, etc. When crushed the blackened portions are seen to be very coarsely punctate. The host occurs under stones along shady brooks, and the parasite is found in the best condition in June and early September. According to Peyritsch this species was first noticed by Mayhr (1852), who considered it a pathological chitinous production.

Laboulbenia subterranea Thaxter. Plate XIII, figs. 9–11.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 163.

More or less suffused with brown, or with two basal cells quite hyaline. Perithecium long, slightly inflated at the base, tapering more or less evenly to the large, blunt, sub-cylindrical apex, the lips of which are turned slightly outward. Appendages arising from two basal cells, the outer very large, almost covering the very small inner one, and continued directly to form the usually very large, long, simple outer appendage, which is septate, slightly constricted at the septa with a marked general constriction usually present towards the base, accompanied by a brown suffusion involving one or more cells. The inner basal cell gives rise to a single short branch bearing one or two antheridia. The black insertion-cell eventually thrust obliquely out-

ward by cell V free from the perithecium. Receptacle sometimes short, more often very long through the elongation of cell II, the distal portion reduced, usually blackish brown, while the two basal cells are hyaline. Perithecia, 135–160 × 50 μ. Outer appendage, longest, 1065 μ; average, 725 μ. Total length to tip of perithecium, 220–480 μ; average, 375 μ.

On *Anophthalmus Menetriesii* Motsch., in limestone caves, Kentucky; *A. pusio* Horn, West Virginia. On *A. Motschulskyi* Schm., Carniola, Austria.

A peculiar and variable species. Forms occurring on the jaws of the host (a blind cave beetle) are short and compact, while others, especially those occurring on the lower surface of the abdomen, are very elongate, The European specimens are small and rather slender, but can hardly be separated from the American material.

Laboulbenia perpendicularis nov. sp. Plate XIII, figs. 15–18.

L. truncata pro parte: Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 45.

Hyaline, becoming more or less suffused with olive brown. Perithecium brown, slightly inflated toward the base, the distal portion often long and narrow, the tip bent inward, its apex broad and flat. Outer appendage rigid, irregular; its basal cell long, followed by two cells, the upper smaller, often inflated, usually followed by a single cell, which bears terminally two rather short branches; inner appendage consisting of a rather large basal cell, the whole inner face of which is occupied by the bases of two long branches set one above the other, projecting across and beyond the perithecium at right angles to the outer appendage; one or both once branched near their tips and bearing a single antheridium from their basal cells. Receptacle distally rather abruptly expanded in the region of cell VI, becoming brownish, the darker distal portions sometimes obscurely punctate. Spores, 65–78 × 5 μ. Perithecia, 120–150 × 45–50 μ. Appendages, outer (longest), 370–400 μ; inner, longest, 350–450. Total length to tip of perithecium, 250–330 μ.

On undetermined species of Bembidium, Connecticut, Virginia (Pergande), Washington (Miss Parker).

This species was at first considered a more fully developed type of *L. truncata*, which is undoubtedly its nearest ally. The differences indicated by the above description seem, however, sufficiently constant to separate it without difficulty, although it is barely possible that *L. truncata* may be the same species greatly modified by its position of growth. The peculiar mode of development by which its inner appendage is made to cross the perithecium at right angles is quite unique. The outer appendage is almost invariably broken off above its third cell, as shown in fig. 15; and the branches of the inner appendage are rarely perfect. But one of these branches (the upper) usually produces its single antheridium, the second, as well as all the portion of the first above the antheridium, being developed after fertilization. Fig. 16 represents the single inner appendage shortly before fertilization has been effected, the short terminal unicellular branch at the right subsequently growing into the elongate appendage shown in fig. 15. There is some variation in the form of the perithecium, which may be more distinctly narrow toward its extremity, and the latter may be more strongly bent inward than is shown by the specimen figured (fig. 15). The species has been observed only on or at the base of the anterior pair of legs.

Laboulbenia truncata Thaxter. Plate XIII, figs. 12–14.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 267.

Dark olive brown, sometimes nearly opaque. Perithecium large, the middle third expanded slightly just above the insertion of the appendages, otherwise sub-cylindrical; the dark truncate apex slightly oblique inwardly, usually as broad as the base, with large, nearly hyaline lips about the pore. Appendages two: the outer straight, stout, dark brown at the base, unbranched, tapering to a slender, hyaline apex: the inner short, slender, simple, hyaline, its base occupying less than a third of the horizontal black disk of insertion, which is situated about opposite the middle of the perithecium. Receptacle short, wedge-shaped: cell I small, triangular, its lower half nearly hyaline, contrasting, its upper as dark as the basal portion of the outer appendage; the darker portions coarsely punctate. Spores, 55–60 × 4.5 μ. Perithecia, 90–100 × 35–40 μ. Appendages, outer, 150 μ. Total length to tip of perithecium, 175–180 μ. Greatest width, 66 μ.

On *Bembidium* sp., New Hartford, Connecticut.

A very small and singular species, distinguished from all others by its perithecium, which is nearly as broad at its hatchet-shaped tip as at its base. It is closely allied to the preceding species, but, as above stated, seems undoubtedly distinct. It has been found but once on an undetermined species of *Bembidium* captured at the margin of a brook in shady woods. It grew crowded on one of the anterior legs of its host.

Laboulbenia Catoscopi Thaxter. Plate XVII, figs. 11–13.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 164.

Pale amber brown, becoming suffused with olive brown at the base of the perithecium and in the region of cell III. Perithecium moderate, the apex rather prominent, blackened except about the pore, the blackening continued downward externally to the body of the perithecium. Outer appendage single, simple, nearly straight, exceeding the perithecium; its basal cell very large, outwardly strongly inflated and blackened. Inner appendage consisting of a much smaller basal cell, from which arise directly two branches, the latter two to three times successively branched with small basal cells and bearing a few solitary antheridia near the base. Receptacle rather elongate, normal, cell IV projecting outward beyond the rather thick black insertion cell, which is situated between the two lower thirds of the perithecium. Spores, 65 × 5 μ. Perithecia, 100–130 × 37 μ. Appendages (longest observed), 110–130 μ. Total length to tip of perithecia, 250–320 μ.

On *Catoscopus guatemalensis* Bates, Mexico. On *Catoscopus spp.*, Liberia, Africa.

Closely resembling *L. elongata* in general form, from which it is at once distinguished by the inflated basal cell of the simple outer appendage. More abundant material may show that the measurements of the appendages given are too small. The fourteen types were obtained from the abdomen of specimens in the collection of the Museum at Cambridge. Further material derived from two species of Catoscopus collected by Professor Cook in Liberia is identical with the Mexican form, although the basal cell of the outer appendage is not so prominently inflated.

Laboulbenia umbonata Thaxter. Plate XV, figs. 9–12.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 163.

Perithecium becoming faintly, sometimes deeply, suffused with brown, projecting free from the receptacle at an angle of about 60°, the outer margin curved inward strongly to the blackish tip, the prominent ear-like lips of which are strongly incurved; a clearly defined rounded prominence on the inner side below the apex. Outer appendage hyaline, or with brown shades, consisting of a large, stout, cylindrical basal portion nearly equalling the receptacle in diameter and length, made up of a basal and somewhat shorter sub-basal cell, from the distal end of which arise two (rarely three) straight, very long and slender, tapering branches. Inner appendage arising from a very small triangular basal cell, its external wall directly continued by that of the outer appendage by which its upper surface is covered, its lower half cutting off obliquely a small portion of the large black insertion cell; its upper half producing sub-laterally a single short appendage, consisting of a single cell, bearing at its apex two rather long antheridia. Receptacle characterized by a stalk-like, slightly inflated base, made up of cells I and II, which are very large, the cells of the distal portion, except cells IV and V, very greatly reduced, so that the perithecium appears to rise almost directly from cell II. Cells IV and V elongated, carrying the broad constricted insertion cell upward, free from the perithecium; the axis of the receptacle coincident with that of the outer appendage. Spores, $60 \times 5\,\mu$. Perithecia, $110 \times 59\,\mu$ (including the hump which projects about $7\,\mu$). Appendages (longest), $925\,\mu$. Receptacle, $155–185 \times 18–33\,\mu$.

On *Stenolophus ochropezus* Say, Kittery Point, Maine, and Cambridge, Mass.

This remarkable form is one of the most clearly distinguished members of the genus, and cannot possibly be confused with any other known species. In old specimens the perithecium, especially its hump-like projection, may become almost black, but the fruiting plant is at first nearly hyaline. The lip-cells of the perithecium are not symmetrical on either side, the inner cell on the right side terminating in a rounded, ear-like tip, that on the left side being longer and narrower. The trichogyne is simple or sparingly branched, slender, and in one specimen spirally coiled toward its tip. The species has been found only on the inferior lateral face of the prothorax of its host on the right side. The beetle is common under stones about ponds, but the fungus seems decidedly rare.

Laboulbenia lepida nov. sp. Plate XIV, figs. 7–10.

Perithecium projecting at an angle to the axis of the receptacle and appendages, hyaline, becoming more or less deeply tinged with smoky brown: the apex blackened, the suffusion extending lower externally; rather evenly inflated, the tip bent strongly outward, the lip-cells prominent, hyaline-tipped, compressed around the pore. Outer appendage consisting of a large basal cell bearing two branches, their basal cells about equal, symmetrically placed and producing each two branchlets, symmetrically divergent, long, slender, somewhat flexuous, hardly tapering and simple. The inner appendage consists of a very small basal cell, from which arise one, usually two, branches, slender, short, once or twice branched, bearing a small number of

antheridia terminally or laterally. Receptacle long and slender, but slightly expanded distally, the large basal and sub-basal cells forming a sub-cylindrical stalk. Spores, 46 × 7 μ. Perithecia, 110–125 × 50 μ. Appendages (longest), 425 μ. Total length to tip of perithecium, 300–330 μ.

On *Anisodactylus nigerrimus* Dej., Cambridge, Mass.

This graceful species was at first taken for a variety of *L. elegans;* yet it seems so constant in its differences that I have concluded to distinguish it as a separate species, the structure of the tips of its perithecium (fig. 8) being its most essential character. Its slender, flexuous appendages, from their form as well as from their mode of branching, also serve as a means of distinguishing it, and seem to vary but slightly from the type represented in the figure. Its position on the host is, singularly enough, exactly the same as that occupied by its near ally, *L. elegans.* It has been found in a single locality only, near the margin of Fresh Pond, where a dozen or more infested hosts have been from time to time obtained.

Laboulbenia elegans Thaxter. Plate XIV, figs. 3–6.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 13.

Hyaline, becoming finally more or less tinged with yellowish brown. Perithecium more or less inflated, abruptly constricted below the deep black apex, the lip-cells very prominent, bent strongly outward from a rounded inner jet-black prominence to the hyaline tips, mouth-like about the pore. Outer appendage arising from a rather large basal cell, above which it produces two branches, the outer simple, rigid, divergent, tapering, the inner producing from its basal cell two branches symmetrically divergent, long, rigid, simple, and tapering: the inner appendage arising from a small basal cell, which produces usually a single branch on either side which may be several times irregularly branched, the branchlets fertile, bearing a few antheridia, singly or in pairs or sterile, often falcate, peculiarly inflated toward the middle and constricted at the septa. Receptacle but slightly expanded distally, the sub-basal cell stouter than the basal, the two usually somewhat inflated and suffused in the region of their common septum. Spores, 40–50 × 4–5 μ. Perithecia, 110–150 × 50–65 μ. Appendages, longer, 250–400 μ; inner, 50–75 μ. Total length to tip of perithecium, 290 μ (larger, 335 μ).

On *Harpalus pennsylvanicus* DeG., New England.

A common and very pretty species, though more stiff and less graceful in its habit than the preceding. It is one of the few forms in which the branching of the outer appendage is almost, though not absolutely, invariable. It is at first perfectly colorless, becoming brownish only in very old individuals, and is very constant in form. It is confined to the lateral face of the prothorax of its host on the right side, where it forms a rather compact tuft just below the projecting margin; but very rarely it occurs, sometimes in company with *L. conferta*, on the corresponding left side, and has been once noticed on the anterior legs. The host is very common, and may be found in late August and early September, devouring the pollen of the common rag weed (*Ambrosia artemisiæfolia*) in open fields.

LABOULBENIA CONFERTA Thaxter. Plate XIV, figs. 12–14.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 268.

Hyaline or tinged with smoky brown, the base of the perithecium and the adjacent cells often dark brown. Perithecium straight, short and broad; tapering rather suddenly towards the apex, which is black except about the hyaline pore, the lip-cells coarse, blunt, turned very slightly outward. Appendages hyaline or brownish; the outer much the largest, its basal cell twice as large as that of the inner, and giving rise typically to three branches, themselves once or twice two- to three-branched above their basal cells; the inner similar but smaller; both the outer and inner varying to more simple forms; insertion cell small, very slightly oblique, placed slightly above the base of the perithecium. Receptacle normal. Spores of usual type, 50 × 16 μ. Perithecium, 130 × 60 μ. Appendages, maximum, 300 μ. Total length to tip of perithecium, 300 μ; greatest breadth, 70 μ.

On *Harpalus pennsylvanicus* DeG., New England.

Except for its color and the branching of its outer appendage this form might readily be taken for one of the varieties of *L. elongata*. It seems certainly distinct from this species, however, as well as from the larger *L. elegans*, with which it is rarely associated, and which it resembles in its general coloration. It usually occurs in a dense tuft on the anterior legs of its host, very rarely also on the left side of the inferior lateral face of the prothorax. Though abundant material has been examined, the species seems comparatively rare.

LABOULBENIA MACROTHECA Thaxter. Plate XVIII, figs. 5–8.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 474.

Clear amber-yellow. Perithecium large, evenly inflated, the curvature, from base to apex nearly symmetrical on either side, the apex rather large, outwardly oblique, with a blackish basal shade; the remainder of the perithecium translucent, amber-colored, the walls thick, the spore mass large. Appendages flexuous, thick, pale amber-colored or tinged with purplish, arising from two cells, the inner small and roundish, the outer much larger, two or three times as long, usually bearing a single cell with two terminal, more commonly simple, branches; the inner producing two branches, each several times branched: the outer appendages especially more or less constricted at the septa. Receptacle small, usually short and slender, the basal cell long, narrowed towards its base, the sub-basal cell short, the remaining cells relatively small. Perithecium, 130–150 × 45–55 μ. Spores, 60 × 5.5 μ. Appendages (longer), 185 μ. Receptacle, 150–165 × 35–40 μ. Total length to tip of perithecium, 240 μ (longest, 270 μ), greatest width, 55–60 μ.

On *Anisodactylus baltimorensis* Say, Maine. On *Anisodactylus sp.* (?) Bathurst, N. B. (H. M. Richards).

This species occurs not rarely on the anterior legs of its host, less frequently on the borders of the elytra. It may be distinguished by its pale amber color, large, evenly inflated perithecium, and slender receptacle, the distal portion of which is relatively unusually reduced. Fig. 6 represents the more typical habit, the basal and sub-basal cell forming a straight, rigid

stalk, gradually expanding upward and characteristically constricted at the common septum. The species is most closely allied to *L. elongata*, but is always readily separable from this species by the characters just mentioned. Although growing exposed to unfavorable conditions near the tips of the anterior legs, it does not assume the short, compact form usually characteristic of species developed in this position.

Laboulbenia arcuata Thaxter. Plate XVIII, figs. 1–4.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 268.

Perithecium smoky-black, becoming uniformly almost opaque; large, narrowed somewhat towards the broad, bluntly rounded, less deeply colored tip, which is nearly symmetrical or bent slightly inward. Outer appendage consisting of a rather large basal cell, from which arise one, often two, branches, which may be simple or once or twice branched; inner appendage arising from a much smaller basal cell, which produces two branches, simple or sparingly branched, bearing usually solitary antheridia laterally. Receptacle at first colorless, contrasting with the dark perithecium; but becoming slightly suffused with brown, the basal cell usually larger than the sub-basal, and strongly curved. Spores, $65 \times 5\,\mu$. Perithecia, $160–185 \times 50–55\,\mu$. Appendages longer, $240\,\mu$. Total length to tip of perithecium, $300–350\,\mu$; average, $320\,\mu$.

On *Harpalus pennsylvanicus* DeG., New England.

This well marked and rather rare species is readily distinguished by its peculiar perithecium. It occurs, so far as I have observed, only on the broad tips of the anterior pair of legs (usually the left) of male individuals, where it is sufficiently conspicuous from its contrasting colors. Though the abundant material obtained is all from New England, the species, together with the remaining forms which inhabit the same host, are all doubtless widely distributed in the United States.

Laboulbenia Harpali Thaxter. Plate XIV, figs. 15–18.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 13.

Hyaline, becoming tinged with brown. Perithecium small, inflated below, tapering to the clearly distinguished, deep blackish-brown tip; bent sidewise from the receptacle, the lip-cells turned outward from the evenly rounded, knob-like extremity to their hyaline tips, which form a slight, pointed projection around the lateral external pore. Outer appendage consisting of a usually somewhat rounded basal cell, from which arise two branches, simple or once to twice branched, their branches rather rigid, tapering, all the cells rather short, inflated and constricted at the septa: inner appendage consisting of a small round cell producing two branches, simple or once branched below, and bearing, usually solitary, lateral antheridia. Basal cell of the receptacle sub-cylindrical, commonly longer than the sub-basal, tapering but slightly to the blunt base; the septum between the two more or less oblique. Spores, $60–68 \times 5–5.5\,\mu$. Perithecia, $90 \times 40\,\mu$. Appendages longer, $200–300\,\mu$. Total length to tip of perithecium, $290\,\mu$ ($215–300\,\mu$).

On *Harpalus pennsylvanicus* DeG., New England.

This very common species is distinguished from all others by the peculiarly modified tip of its small perithecium. It grows, appressed and densely crowded, invariably on the anterior

inferior margin of the thorax and the adjacent posterior margin of the prothorax. It is subject to but slight variation, and is doubtless widely distributed.

LABOULBENIA INFLATA Thaxter. Plate XVII, figs. 4–6; Plate III, fig. 5.

Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 41.

Hyaline, becoming tinged with brown. Perithecium more or less inflated, narrowed towards the broad, blunt, often symmetrically rounded apex, becoming more or less suffused with brown, projecting outward from the receptacle. Outer appendage simple, tapering, its base made up of three short, superposed, conspicuously inflated cells constricted at the blackened septa, the distal portion more remotely septate, not inflated or constricted; the inner appendage rises from a basal cell, nearly as large as that of the outer, which gives rise to two simple, hardly divergent branches, one to three of the basal cells of which are inflated as in the outer appendages. Receptacle normal. Spores, $50 \times 4.5\ \mu$. Perithecia, average, $90 \times 37\ \mu$ (largest, $110 \times 50\ \mu$). Appendages, longest, $185\ \mu$. Total length to tip of perithecium, 150–200 μ.

On *Bradycellus rupestris* Say, South Dakota (Aldrich), Kittery Point, Maine, and Waverly, Mass.; Newport, R. I. (Richards).

This very pretty and well marked species appears to be not uncommon on the above mentioned host, which is probably identical with the beetle on which the original types were found; although this was, by an oversight, stated to be a species of Bembidium. It is distinct from all other species in the character of its appendages, and could not be mistaken for any described form unless, perhaps, *L. Philonthi*, to which it bears a slight superficial resemblance.

LABOULBENIA COMPRESSA Thaxter. Plate XIV, figs. 1–2, 11.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 165.

Pale yellowish. Perithecium becoming tinged with olive-brown, inflated, the lip cells compressed to form an evenly rounded, narrow, prominent apex, which is commonly bent slightly outward, and blackish brown except about the pore, which is external and lateral. Outer appendages simple or once branched above its sub-basal cell, the lower cells slightly inflated, the branches straight and tapering. From the inner basal cell arise two branches, which may be simple or once branched, the sterile branches like the outer appendage. Receptacle normal, the basal cell usually curved. Spores, 50×3.7–$4\ \mu$. Perithecia, 85–100 $\times\ 30\ \mu$. Appendages, longest, 150–200 μ. Total length to tip of perithecium, 175–260 μ, average, 210 μ.

On *Anisodactylus baltimorensis* Say, Kittery Point, Maine.

This small species in its typical form is hardly to be confused with any other by reason of its narrowly pointed perithecium; but specimens are sometimes found which indicate that it is very closely related to *L. filifera*, of which it may possibly prove to be a variety. It is almost invariably found at the base of the middle pair of legs of its host, usually at the right, rarely on the elytra, and is not very common. The spores are remarkably long and slender in proportion to the size of the perithecium. The hosts affected were found under stones about muddy ponds.

Laboulbenia filifera Thaxter. Plate XIV, figs. 19–22.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 165.

Perithecium tinged with olive-brown, the apex deeply blackened, broad, more or less evenly rounded, or nearly truncate, often symmetrical. Appendages consisting of two basal cells, the inner minute, the outer large, usually followed by a sub-basal cell, from which arise two very elongate, simple, erect, rather closely septate branches, at first dark brown above their nearly hyaline basal cells. The inner appendage consists of two short, hyaline, fertile branches, one of which may produce a long and sterile branch. Receptacle short, about equalling the perithecium in length, the anterior margin rather abruptly diverging above cell II. Spores, about $50 \times 4\,\mu$. Perithecia, average, $25 \times 90\,\mu$. Appendages, longest, $550\,\mu$. Total length to tip of perithecium, 150–190 μ.

On *Anisodactylus Harrisii* Lec., *A. nigerrimus* Dej., *A. interpunctatus* Kirby, *Harpalus pleuriticus* Kirby, and *H. erythropus* Dej., Maine, Massachusetts, Pennsylvania.

A common species found usually densely crowded along the outer margin of the elytra towards their base, less frequently elsewhere. The very long outer appendage is usually broken off in part. The two specimens figured are type forms, but the tip of the perithecium is not in all cases so abruptly truncate, and the lip-cells are sometimes distinctly turned outward with a sub-hyaline area about the lateral pore. The hosts are common everywhere about ponds and in fields.

Laboulbenia Hageni Thaxter. Plate XVII, figs. 20–22; Plate III, fig. 4.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 470.

More or less deeply tinged with brown. Perithecium slightly inflated, tapering to the blunt outwardly oblique apex, which is blackened below the hyaline lips. Appendages arising from an outer and an inner basal cell, the outer of which is followed by a squarish cell of about the same size, from the end of which project four rather short, rigid, slightly divergent hyaline branches, which taper to blunt tips, and, as a rule, hardly exceed the tip of the perithecium: the inner basal cell gives rise to two squarish cells, one on either side, each of which bears usually a pair of branches similar to those just described. Receptacle short and stout, normal in form, the lower portion of the basal cell hyaline. Perithecia, $55 \times 18\,\mu$. Appendages (longest), $65\,\mu$. Total length to tip of perithecium, $100\,\mu$.

On *Termes bellicosus* var. *mozambica* Hagen, Africa.

The occurrence of a most typical and decidedly insignificant looking species of this genus on a larva of the worker of a species of white ant is certainly quite unexpected in view of the wide difference which exists between this neuropterous host and the usual insects infested by the genus. But for the four stiff branches arising from the sub-basal cell of the outer appendage, and suggesting the roots of a molar tooth, it would be difficult to specify its distinguishing characters unless it be the fact that it is the smallest species of the genus. The species is dedicated to the memory of the late Professor Hagen, by whom it was observed many years since on the same specimen examined by the writer, collected by Dr. Peters in Africa, from all parts of which sufficiently abundant material was obtained.

LABOULBENIA PARVULA Thaxter. Plate XIV, figs. 22–24; Plate II, fig. 10.

Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 41.

Tinged with olive, becoming deep olive brown, sometimes nearly opaque. Perithecium straight, inflated below the broad, squarish apex. Outer appendage almost opaque externally at its base, consisting of a large basal cell producing distally two branches, one terminal, the other lateral or sub-lateral, both once or twice branched above their basal cells; inner appendage consisting of a smaller basal cell which gives rise to typically two branches, each once or twice branched, the ultimate branches in both appendages rigid, sub-cylindrical, erect or but slightly divergent, slender. Receptacle stout, sub-triangular; the basal cell small, hyaline or translucent, the rest eventually nearly opaque, obscurely punctate. Spores, $40 \times 4\,\mu$. Perithecia, $90–110 \times 30–40\,\mu$. Appendages, longest, $110–200\,\mu$. Total length to tip of perithecium, average, $180–190\,\mu$.

On *Platynus extensicollis* Say, *P. æruginosus* Dej., *P. striatopunctatus* Dej., Maine to South Carolina. On *Bembidium bimaculatum* Kirby, Washington (Miss Parker).

This small and well defined species occurs often in great numbers on the legs (usually the posterior) of its host, and not elsewhere. It was first sent me on *P. extensicollis* by Mr. Pergande, and has since been found in various localities. The appendages are, as a rule, more or less broken, and perfect specimens such as those represented in the figures are not frequently met with. When uninjured, the slender, terminal portion of the appendages is quite characteristic, but when the latter have been broken, as from the position of growth upon the host they are very likely to have been, the new branches which grow out to replace the primary ones are apt to be shorter, stouter, and without the characteristic form just mentioned. A curious development of filaments from the basal cells of a perithecium which had been partly broken off in an individual of this species, is represented in Plate II, fig. 10, and several similar instances have been observed.

LABOULBENIA SCELOPHILA Thaxter. Plate XIV, figs. 23–26.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 269.

Becoming more or less suffused with olive-brown except the nearly hyaline basal cell. Perithecium rather evenly inflated, the apex rather broad, the inner lip-cells prominent, bent slightly outward. Outer appendage consisting of a sub-cylindrical basal cell, producing distally a terminal and on its inner side a sub-terminal branch, the outer usually simple, the inner once branched above its basal cell: inner appendage consisting of a somewhat smaller but similar basal cell which produces two branches simple or once branched, bearing laterally several long, slender, curved antheridia; both appendages with their branches hardly divergent, sub-parallel and curved strongly towards and past the tip of the perithecium. Receptacle sub-triangular, short and rather stout, the partition between cells II and VI very oblique, the basal cell small, sub-triangular, hyaline. Spores, $50 \times 5\,\mu$. Perithecia, $100–120 \times 40–50\,\mu$. Appendages, longest, $180\,\mu$. Total length to tip of perithecium, $200–220\,\mu$.

On *Platynus extensicollis* Say, New England.

This small species is allied to *L. parvula* in general form, but is at once separable by its stouter curved appendages. It occurs only on the legs of the host mentioned, usually in small numbers, and is very constant in its characters.

Laboulbenia recta Thaxter. Plate XIV, figs. 27–28.

Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 42.

Olivaceous. Perithecium straight, rather small, symmetrically inflated, the short, almost truncate, black apex abruptly distinguished; the wall-cells distinctly spiral. Outer appendage consisting of a basal cell bearing distally a terminal and on the inner side a sub-terminal branch; each usually once branched above its basal cell: the inner appendage consisting of a much smaller basal cell, producing two branches, each of which may be once branched, the ultimate branchlets of both appendages stiff, erect or diverging slightly towards the perithecium, tapering slightly, rather closely septate and about equal. Receptacle long, straight and rather slender. Spores, 75–80 × 6–7 μ. Appendages, longest, 200–250 μ. Perithecia, 150–180 × 50–75 μ. Total length to tip of perithecium, 350–430 μ.

On *Platynus extensicollis* Say, Maine and Connecticut.

This rare species was found in several localities about New Haven and at York, Maine, attached to the anterior legs of its host in company with *L. scelophila*, which is, perhaps, its nearest ally; although readily distinguished by its smaller size, different shape and curved appendages. It is one of the few species in which the longitudinal series of wall-cells of the perithecium have a spiral twist.

Laboulbenia cristata Thaxter. Plate II, figs. 2–3; Plate XVII, figs. 24–29.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 174.

More or less suffused with brown. Perithecium curved outward, evenly, often deeply, suffused with brown, tapering to the neck-like apex, its prominent lips turned outward, the base of the inner lip more deeply suffused. Appendages two, the outer consisting of a large, squarish cell surmounted by a sub-basal cell which bears on its upper flattened surface a series of from three to six large, straight, simple, septate dark red-brown branches set side by side antero-posteriorly in a single row, the inner very long, the outermost basally deeply blackened and contracted, curved strongly outward, its hyaline sub-erect distal portion commonly broken off. The inner basal cell very small, producing usually two short branches bearing groups of large, long-necked antheridia. Trichogyne large, branched and septate, the ultimate branches straight and tapering. Receptacle short, stout, hyaline, becoming tinged with yellowish brown. Cell I small, cell II very large, all very thick-walled. Spores, 50–55 × 4–4.5 μ. Perithecia, 110–130 × 37–45 μ. Appendages (outer, not including two basal cells), 90–480 μ, basal cells, 35 μ. Total length to tip of perithecium, 250–280 μ.

On *Pæderus littorarius* Grav., and *P. obliteratus* Lec., Maine; *Pæderus* sp.? Mexico and Nicaragua; *Pæderus ruficollis* Fabr., Austria.

A very well marked and in the case of well developed specimens one of the most striking species of the genus, easily recognized by the crest-like series of branches from the outer appendage, which, however, varies very considerably. The specimens from Mexico and Europe illustrate the extremes of development as far as the appendages are concerned, fig. 29 representing a specimen from the first mentioned locality. The species is rather common in dry or moist situations, the hosts being abundant in rubbish in cultivated land. It is doubtless this form which is mentioned by Rouget as occurring on *Pæderus* in France and confused by him with *L. Rougetii*. It is a distinctly isolated form, and cannot be said to be definitely related to any of the known species of the genus except the following, although an undescribed form occurs on Bledius, which approaches it in some respects.

Laboulbenia Diopsis nov. sp. Plate III, fig. 6.

Perithecium dull amber brown, a blackish patch below the hyaline lip margins on the inner side, the inner edge rather straight, the apex large, prominent and somewhat abruptly distinguished, the insertion of the trichogyne usually conspicuous. Receptacle often very long-stalked through the great elongation of cell II; the distal portion small, compact, rather abruptly distinguished from cell II, its cells more or less uniform in size; the whole tinged with brown, the distal part more deeply. Appendages arising from an inner and an outer cell, the inner usually producing two short two- to three-celled branches bearing the long, slender antheridia; the outer followed by three cells: the lower producing from their inner side one, rarely two, superposed branches, the upper a crest-like series of branches arranged antero-posteriorly in a single row. All the branches more or less deeply tinged with brown, somewhat constricted at the septa, rarely furcate above the basal cell, often tending to grow stouter distally, the terminal cell of each bluntly rounded or tapering but slightly. Spores, about $7 \times 5.5\ \mu$. Perithecia, $110–140 \times 30–38\ \mu$. Receptacle: distal portion about $35 \times 50\ \mu$. Cell II, $200–500 \times 25\ \mu$. Total length to tip of perithecium, $300–800\ \mu$.

On *Diopsis thoracica* Westw., Coffee Hill, Liberia, Africa (O. F. Cook).

This curious form, which was first observed on its singular host by Professor Cook, is the first species of the genus which has been found on a dipterous insect, in the present instance a fly with stalked eyes, and, according to Professor Cook, with riparian habits. It seems in general to be subject to little variation except in the length of cell II, which may be greatly elongated. In the general form of its perithecium and receptacle it recalls to some extent *L. subterranea*; but it is undoubtedly more closely related to *L. cristata* than to any other species, as is indicated by the form of its appendages and antheridia, as well as by the outline of its perithecium. The types were found on the legs and abdomen as well as on the eye stalks of the host on which, from their length and dark color, they are quite conspicuous.

Laboulbenia Brachini Thaxter. Plate XX, figs. 1–8.

Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 40.

Amber yellow, becoming more or less suffused with amber brown. Perithecium rather small and stout, somewhat inflated, the apex deep black, large, bluntly rounded. Appendages

consisting of two basal cells, the outer becoming blackened, bearing terminally a variable number of branches arranged in a single antero-posterior fan-like series; the branches mostly furcate near the base, the inner producing short, somewhat specialized antheridial branchlets, bearing terminally two to five antheridia. Receptacle variable, often short and stout, sometimes elongate, normal in form. Spores, 75–85 × 8 μ. Perithecia (average), 165 × 75 μ. Appendages, longest, about 375 μ. Total length to tip of perithecium, 150–650 μ. Average, 525 μ.

On *Brachinus*, several species, Maine to Texas. On *B. mexicanus* Dej., Oaxaca, Mexico.

This well marked form, although subject to very considerable variations in size, shape and in the character of its appendages, can hardly be confused with any other species. In exceptional cases the appendages are comparatively simple, as in fig. 2, in which the inner basal cell bears two ordinary branches in the usual way, but in the great majority of cases this cell becomes proliferous from its inner upper angle, each successive proliferation resulting in a branch, the resultant groups of branches forming, with the outer appendage, a crest-like series (figs. 1 and 3) of very characteristic appearance. The appendages are very apt to be broken, especially the outmost branches, which are often deeply blackened (fig. 3). When growing on the legs and jaws the specimens are usually very small and stout (fig. 1); but on other portions of the host very elongate forms often occur. The species is by no means uncommon, and has been found in numerous localities about Cambridge and Kittery (Maine). In two specimens from the last locality, fine trichogynes were obtained which are copiously branched, many of the terminal branchlets having a spiral habit and ending in a distinct knob-like enlargement. The antheridial branchlets, although not as highly developed, recall those of *L. variabilis* which, however, does not seem otherwise nearly related. The hosts are more often found under stones about ponds and streams, and are recognized by their habit of discharging a cloud of pungent vapor when disturbed.

Laboulbenia zanzibarina Thaxter. Plate XVII, figs. 1–3.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 175.

Olive brown, the basal cell nearly hyaline. Perithecium rather large, more deeply colored below the somewhat suffused tips of the lip-cells, the latter not prominently distinguished, forming a slightly enlarged, broad, somewhat flat-tipped, almost straight apex. Appendages consisting of two basal cells, the outer producing externally a single obliquely vertical series of branches, their basal cells inwardly concave and bearing externally a secondary series of branchlets arising like the primary ones and producing branchlets of the third order: the inner basal cell producing similar shorter series of branches on either side; the branches, like those of the outer appendage, some of them producing antheridial branchlets bearing a terminal row of antheridia; all the ultimate sterile branchlets of both appendages similar, cylindrical, bent slightly towards the perithecium. Receptacle becoming nearly opaque, its dark portions distinctly punctate, cell I hyaline, cell VI continued downward. Spores about 50 μ long. Perithecia, 100–110 × 3.7 μ. Appendages (longest), 200 μ. Total length to tip of perithecium, 185–200 μ.

On *Crepidogaster bimaculata* Boh, Zanzibar, Africa.

The appendages of this curious species distinguish it from all others, and in their successive one-sided branching recall those of the genus Teratomyces, this one-sided habit being even characteristic of the antheridial branchlets (fig. 3). It is scarcely possible to determine in the material available whether the inner basal cell produces a series of branches on either side or only one series. Assuming that the last is true, the fundamental habit of branching is not unlike that of *L. Brachini*, although the insertion of the primary series in the latter is more nearly horizontal. The types were taken from a specimen of the host in the Museum of Comparative Zoology, growing at the tips of the elytra and on the adjacent portions of the abdomen.

Laboulbenia Galeritæ Thaxter. Plate XIX, figs. 9–12.

Proc. Am. Acad. Arts and Sci., Vol. XXVII, p. 39.

Perithecium becoming almost opaque, transversely punctate, elongate, sub-cylindrical, tapering rather abruptly to the blunt apex ; the lip-cells turned slightly outward ; the basal wall-cells forming an abruptly differentiated, clearly defined hyaline neck-like base. Appendages consisting of two basal cells, hyaline above, black below, above which rise three connected series of superposed cells ; one outer and two inner, each producing from three to six single simple branches, and forming a sub-conical body : the branches, one from each cell, tapering slightly, their distal portions straight, slightly divergent, hyaline, remotely septate : the basal portion more or less suffused with blackish brown, more closely septate, the segments inflated and constricted at the blackened septa. One or two of the lower branches from the two inner series are fertile, consisting of a single cell bearing terminally a group of from two to five long-necked, slightly curved, brownish antheridia. Insertion cell broad, free from the base of the perithecium. Receptacle variable, often elongate, cells III and IV externally or almost wholly blackened and opaque, the remaining cells hyaline or with brown suffusions. Spores, $50 \times 5.5\ \mu$. Perithecia $155 \times 37\ \mu$. Appendages (longer branches), $350\ \mu$. Total length to tip of perithecium, $375\ \mu$. Maximum, $600\ \mu$.

On *Galerita janus* Fabr., District of Columbia (Pergande) to Alabama (Henderson); *G. atripes* Lec., Kansas ; *Galerita* sp., Iowa ; *G. mexicana* Dej., Mexico.

This common and well marked species is apparently widely distributed, and can hardly be confused with any other form unless it be the succeeding species ; which is, however, immediately separable by the position of cell III, although in both the same more or less conical or pyramidal base gives rise to the three vertical series of branches, two inner and lateral and one outer, which are so characteristic in their appearance. In some cases the tips of these branches have a spiral twist, which is probably accidental, but otherwise the species is a very constant one. I know of no other form in which the perithecium is so conspicuously punctate, the spots being arranged more frequently in rather definite transverse lines and themselves often elongated transversely. The species occurs scattered indefinitely over the surface of its host, more often on the elytra.

Laboulbenia decipiens Thaxter. Plate XX, figs. 19–21.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 473.

Perithecium nearly opaque, not punctate, large, slightly and evenly inflated, tapering rather abruptly to the nearly symmetrical apex ; the basal wall-cells forming a short, stout, clearly-defined, hyaline neck ; the septa separating the upper wall-cells, deeper blackish and spirally twisted. Appendages consisting, as in *L. Galeritæ*, of a conical cellular base consisting of one outer and two inner rows of superposed cells, each of which bears a single simple, straight, septate branch, its lower segments slightly inflated, hardly exceeding the tip of the perithecium. Antheridia blackish, with a very long curved neck, borne singly or two together from the sub-basal cell of the inner series of superposed cells. Receptacle as in *L. Galeritæ*, except that cell III extends upward nearly to the black insertion cell of the appendages, cells IV and V being wholly included by it. Color sub-hyaline, with brownish suffusions especially in the region of cells IV and V. Perithecium, 175–278 × 55 μ (smallest, 130 × 37 μ), its stalk-like base, 40–55 × 30 μ. Receptacle (larger), 300 × 75 μ.

On *Galerita æquinoctialis* Chaud., Guatemala, and *G. nigra*, Chev., Mexico.

This species is remarkable for its close resemblance to *L. Galeritæ*. It is at once distinguished by the position of cell III and by the peculiar twist of its perithecial wall-cells, which are not punctate, as in the latter species, and differs further in the form and size of its antheridia as well as in the branches of its appendages, which are more numerous as a rule and, as far as can be determined, from the rather poor material available, much shorter. The thirty-six types were obtained from specimens in the Museum of Comparative Zoology.

Laboulbenia mexicana Thaxter. Plate XIX, figs. 1–3.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 171.

Pale amber-colored, the basal cell and mature perithecium more deeply suffused. Perithecium large, straight, thick-walled, the black hyaline-lipped apex abruptly distinguished, nearly symmetrical. Appendages hardly exceeding the perithecium, consisting of two basal cells, the outer giving rise to two branches, an outer usually simple, more deeply suffused, and an inner larger, once or twice branched. From the inner basal cell arise two branches on either side, once or twice successively branched, and bearing a few single antheridia laterally. Receptacle elongate, often abnormally septate, the basal cells of the perithecium large and distinct and forming a broad, more than usually well defined base. Spores, 90–100 × 7 μ. Perithecia, 200–240 × 65 μ. Appendages, longest, 220 μ. Total length to tip of perithecium, 500–600 μ.

On *Galerita mexicana* Chaud., *G. nigra* Chev., *G. æquinoctialis* Chaud., Mexico and Nicaragua.

One of the largest species of the genus occurring on the elytra of its hosts, where it is conspicuous from its light color. It is of interest as affording an instance of a transitional condition between the ordinary sessile perithecium and the long-necked forms like those of *L. longicollis*, *L. Kunkeli*, and others. The lower series of perithecial wall-cells are in the present

species much shortened about the base, and in some cases show a tendency to form a stout stalk, the sub-basal series occupying almost the whole length of the perithecium. The types examined were derived from specimens in the Museum of Comparative Zoology.

Laboulbenia melanotheca Thaxter. Plate XIX, fig. 4.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 472.

Tinged with pale reddish brown, except the nearly black perithecium. Perithecium long, straight, symmetrical, sub-cylindrical or but slightly inflated, narrowed abruptly to the symmetrical apex, its basal wall-cells elongated to form a neck-like stalk about one-fourth as long as its main body, projecting from the receptacle at an angle to its long axis towards and beyond the appendages. Appendages as in *L. mexicana*, hardly exceeding the perithecium in length, consisting of two basal cells: the outer producing an outer and an inner branch either simple or once branched; the inner producing single branches on either side. Receptacle elongate, expanding very gradually from the base, distally abruptly rounded and contracted below the insertion cell on one side and the neck-like base of the perithecium on the other. Spores, $95 \times 5.5\,\mu$. Perithecium, $220–245 \times 60–65\,\mu$, its neck-like base about $75 \times 30\,\mu$. Receptacle about $515 \times 100\,\mu$. Total length to tip of perithecium, $800–835\,\mu$.

On *Galerita mexicana* Chaud., Nicaragua.

This species has been previously referred to by the writer as a possible hybrid between *L. mexicana* and *L. Galeritæ*. It seems on more careful comparison, however, to be abundantly distinct from either. The neck-like base of the perithecium formed from the elongated basal wall-cells of the perithecium lie wholly below the ascogenic cells. The eight types were found on the elytra of their host in company with *L. mexicana*.

Laboulbenia longicollis Thaxter. Plate XIX, figs. 5–8.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 172.

Perithecium becoming suffused with dark brown, straight, thick-walled, often slightly inflated, the apex short, rather large, abruptly distinguished, black, its lips hyaline, turned slightly inward. Appendages consisting of two basal cells, the inner smaller, bearing distally two rounded cells, the upper surface of each blackened and bearing two to five branches, which arise side by side and spreading laterally may be successively and similarly twice branched, the whole having a fan-like habit, the ultimate branches usually one to three in number, either bearing two to three long-necked, straight antheridia, or sterile, somewhat elongate, straight and tapering. The outer basal cell superiorly and externally blackened, the blackened ridge extending obliquely outward and downward nearly to the base, bearing a row of closely set branches of variable number (three to five) which are successively three to five times dichotomously branched, the ultimate branches suffused with brown, straight, slender, tapering, arising from a short characteristically bent basal cell; the basal cells of all the main branches hyaline, slightly inflated inwardly, the septa black, contrasting. Receptacle large, cell V as large or nearly as large as cell IV, the neck of the perithecium about $175\,\mu$ in length. Spores, $75 \times 6.5\,\mu$. Peri-

thecium, 180–220 × 50–60 μ. Longest appendages, 510 μ. Total length to tip of perithecium, 500–780 μ.

On elytra of *Galerita leptodera* Chaud., Guinea; *Galerita* sp., Liberia, Africa.

The figures of this species were drawn from a small amount of very poor material found on a specimen of *G. leptodera* in the collection of the Cambridge Museum, and do not give a very good idea of the fully developed appendages. Abundant material has since been obtained from specimens of an undetermined Galerita collected by Professor Cook in Liberia. When perfect the species is one of the most striking of the genus in appearance from the copious development of its peculiar branches and its often greatly elongated neck. It is most nearly allied to *L. Galeritæ*, and represents the highest development of this peculiar type. The very numerous specimens examined were found for the most part on the upper surface of the hosts.

Laboulbenia Kunkeli Thaxter. Plate XVIII, figs. 9–10.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 471; *Thaxteria Kunkelii* Giard. Comptes Rendus Hebdom. d. Séances d. l. Soc. Biol. Sér. IX, Vol. IV, p. 156.

Perithecium blackish brown, nearly opaque, strongly curved outward, sub-cylindrical or somewhat thickened distally, tapering somewhat abruptly to the rather small, nearly truncate tip; the lip-cells distinct, the inner smaller and often slightly more prominent; the lower series of wall-cells elongated to form a hyaline, slender, cylindrical stalk somewhat shorter than the ascigerous portion above it. Appendages consisting of two basal cells; the outer becoming opaque, producing usually two branches, one external, smaller, opaque, one to three times sympodially branched, the other terminal four to nine times sympodially branched like the first in an antero-posterior plane, erect, the branchlets sub-hyaline at the tips, the whole otherwise opaque. The inner appendage consists of a basal cell, from which arise two branches, which, curving outward, diverge on either side, rarely simple, usually furcate above their deeply suffused sub-basal cell; their basal cell several times as large, inflated, sub-hyaline, suffused above and below; the secondary branches sympodially about six times branched, the branchlets like those of the outer appendage. Receptacle long and very slender, cell VI greatly elongated and very narrow, cells III and IV elongate, nearly equal, all the cells punctate or mottled with somewhat darker, transversely elongate patches, cell II often brownish or quite opaque, the opacity involving part of cell I, the remaining cells and sometimes the whole receptacle sub-hyaline or pale yellowish brown. Spores, 185 × 14 μ. Perithecia (sporiferous portion), 360–585 × 75–85 μ; stalk, 320–375 × 60 μ. Appendages, longer, about 500 μ. Receptacle, longer, 1.3 mm. Total length, longer, 2.2 mm.

On *Mormolyce phyllodes* Hagenb., Perak, E. Indies.

The twelve specimens from which the above description is derived were obtained from the specimen of Mormolyce originally examined by Professor Giard and kindly communicated by him, and were taken from the elytra, thorax, and abdomen near the base of the legs. In all these situations, even where mingled with the succeeding species, the present form seems to present sufficiently constant differences to justify its separation from *L. palmella*, with which it was originally confused. Although its habit and the branching and character of its appendages

is distinctly peculiar, it should, I think, certainly be referred to the present genus, since it conforms in every essential point to the type structure found throughout the series, and is less peculiarly modified in important points than very many of the remaining species. The dimensions given by Giard are much greater than those of the specimens which I have examined. The smallest specimen among these measures 1.17 mm. in length, while the largest hardly exceeds 2.2 mm. According to Giard, however, specimens of medium size measure 3.132 mm., while larger individuals may reach 4 mm. in length. In any case, however, the species is by far the largest of all the Laboulbeniaceæ, as well as one of the most striking. Both this and the succeeding form appear to be more closely related to *L. longicollis* and what may be called the *Galeritæ* group of the genus than to any other, but apart from the production of a perithecial neck the resemblance is not very close in any case.

Laboulbenia palmella Thaxter. Plate XVIII, figs. 11–20.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 471.

Perithecium nearly straight, almost opaque, sometimes slightly inflated, its tip nearly symmetrical, truncate, its inner walls often having a corrugated appearance, the four lower wall-cells elongated and contracted to form a short stalk below and about one third as long as the ascigerous portion. Appendages rigid and but slightly divergent, arising from two small basal cells: *an outer* which gives rise to a series of two or three opaque branches placed antero-posteriorly, the inner of which alone reaches any considerable size, branching sympodially in an antero-posterior plane, the main axis opaque, successively inflated below the branchlets, which are usually about ten in number, opaque with hyaline tips; *an inner* which gives rise to a single branch on either side, consisting of a sub-cylindrical basal cell, black below, nearly hyaline above and followed by a series of sympodial branchlets like those of the outer appendage. Receptacle short, tapering rapidly to the base, wholly black and opaque with the exception of the whole or a portion of its basal cell, which may be hyaline, and is abruptly bent above the very large hoof-like haustorium or blackened point of attachment. Spores, $150 \times 12\,\mu$. Perithecium, $475–580 \times 75–110\,\mu$, its neck, $75–150 \times 35–65\,\mu$. Receptacle, $300–400\,\mu$, its greatest width, $75–100\,\mu$. Appendages (longest), $500\,\mu$, the branchlets about $225–250 \times 7–8\,\mu$. Total length to tip of perithecium, 1–1.1 mm.

On *Mormolyce phyllodes* Hagenb., Perak, Molucca, Java.

The writer is indebted to the late Professor Riley for abundant material of this species found by Mr. Schwarz on a specimen of Mormolyce in the National Museum labelled "Java," as well as to Mr. Beutenmueller, who has kindly sent material derived from a specimen in the Central Park Museum labelled Molucca, and to Professor Giard, who has also generously allowed him to examine the original specimen of Mormolyce from Perak, on which the types of *L. Kunkelii* were associated with the present species. The two species are very closely allied, and were found intermingled toward the base of the elytra, although the smaller was much more abundant on the flattened margins, where it presents the appearance under a hand lens of a grove of little palm-trees. The absence of any transitional forms between the two species seems to render it unlikely that they should prove merely varieties of a single form, while the

much smaller size of *L. palmella*, its wholly opaque and short receptacle, straight, short-necked, proportionately stouter perithecium, large hoof-like base, together with the absence of furcation in the main axis of the two lateral branches of its inner appendage, afford sufficient specific differences. The antheridia appear to be represented by flask-shaped bodies borne on short hyaline branches near the tips of the branchlets of the inner appendages. The trichogynes are well developed and more or less copiously branched. The very large amount of material examined indicates that this species is subject to little variation in form and is relatively constant in size.

Laboulbenia Pheropsophi Thaxter. Plate XX, figs. 13–15.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 170.

Perithecium becoming suffused with blackish brown, straight, the two upper thirds free from the receptacle, rather slender, the outer margin curving abruptly inward to the base of the prominent tip, which is itself bent slightly outward, its base deeply suffused. Outer appendage slightly divergent, somewhat exceeding the perithecium, composed of usually five or six superposed cells, somewhat longer than broad, each of which gives rise externally from its upper half to a single simple short branch, tapering distally, slightly constricted near the base, where it is divided by a blackened septum: insertion-cell rather broad, black, and considerably exceeded externally by the free upper surface of cell IV. Inner appendage smaller and similar or once to twice sub-dichotomously branched above its basal cell, the lower septa blackened. Receptacle normal, cell II usually hyaline, the rest becoming suffused with olive-brown. Spores, $75 \times 4.5\ \mu$. Perithecia, $150 \times 50\ \mu$. External appendage, $100–150\ \mu$, its branches about $50\ \mu$ long. Total length to tip of perithecium, $250–500\ \mu$.

On *Pheropsophus æquinoctialis* Linn., and several undetermined species from South America. On *P. marginatus* Dej. var. ? from Zanzibar, and *Pheropsophus sp. indet.*, Liberia, Africa (O. F. Cook).

This form appears to be common on species of Pheropsophus from South America occurring on all parts of the host. In general form it is much like some varieties of *L. elongata*, but is at once separable by its appendages, which are peculiar both in form and method of branching. Among the hosts examined in the collection of the Museum of Comparative Zoology one labelled "*P. marginatus* Dej., var (?)" from Zanzibar, was found to bear a small number of specimens of a Laboulbenia apparently identical with this species except that the antheridia were long with slender necks and borne terminally in pairs on short branches. All the specimens are, however, immature, so that it is impossible to determine whether it possesses other distinctive characters. The types vary somewhat in the relative development of the inner appendage, and the form is often more slender than is represented by the figure. Additional material on Pheropsophus from Liberia collected by Professor Cook has since been obtained, and although the difference above noted in the antheridia is observable in these also they do not seem to be specifically distinct from the South American types, which they otherwise resemble in all respects.

Laboulbenia Panagæi Thaxter. Plate XIX, figs. 17–20.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 170.

Perithecium becoming wholly suffused with blackish brown, straight, thick-walled, cylindrical or slightly inflated, the apex truncate or slightly oblique outward, the outer lip nearly hyaline. Appendages arising opposite the base of the perithecium, consisting of two equally broad basal cells, the inner shorter, bearing each a single cell from which arise from three to five usually simple branches hardly exceeding the perithecium, the lower cells usually inflated, the septa blackened, as is the outer wall of the external basal cell. Receptacle normal, cells III and IV blackened externally or wholly, the suffusion becoming general in older individuals, in which the basal cells of the perithecium may become elongated to form a neck-like base free from the insertion-cell of the appendages, which becomes pushed out quite free from the perithecium by the elongation of cells IV and V. Perithecia, 100–150 × 35–40 μ. Longer appendages, 250–330 μ. Total length to tip of perithecium, 240–330 μ.

On elytra and thorax of *Panagæus crucigerus* Say, and *P. fasciatus* Say, Southern United States.

Specimens occurring upon *P. crucigerus* are decidedly larger and more elongate than those observed upon the smaller species. The form belongs to the group of which *L. Galeritæ* may be taken as the type, in which the lower series of wall-cells tends to form a neck-like base. The inflated cells of the appendages recall those of *L. inflata*, but the two species are not related. The hosts affected are myrmecophilus Carabidæ, inhabiting ants' nests.

Laboulbenia australiensis. Plate XIX, figs. 13–16.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 171.

Perithecium as in the preceding species, less deeply suffused and supported in older individuals by a more or less neck-like base. Appendages consisting of two closely united basal cells; the outer much the largest, and giving rise directly to two branches, the outer deeply suffused with olive-brown, the inner once or twice branched, hyaline or with suffused tips. The inner basal cell gives rise to one or two branches, simple or once or twice branched; the insertion-cell black, thick and rather narrow, placed opposite the base of the perithecium. Receptacle normal, except for the eventually neck-like hyaline base of the perithecium, hyaline, becoming suffused with olive-brown, especially in the region of cells II, III, and VI. Spores, 74 × 5.5 μ. Perithecia, 110–148 × 38 μ. Longest appendages, 222 μ. Total length to tip of perithecium, 220–300 μ.

On elytra of *Acrogenys hirsuta* McLean, Australia.

This species appears to be allied to *L. Panagæi*, although the appendages are very different in character. The available material is not abundant and is in rather poor condition, yet the species seems sufficiently well marked.

Laboulbenia Coptoderæ Thaxter. Plate XVII, figs. 14–15.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 168.

More or less suffused with faintly olive brown. Perithecium rather large, the apex, which is bent slightly outward, dark, the lateral lips forming a slight angular prominence over the lateral external pore. Appendages two, the outer single, curved outward, blackened externally or wholly opaque, giving rise from its convex side to several successive branches rather irregular in outline and often once branched above their basal cells. Inner appendage consisting of a larger basal cell, which gives rise from its apex on either side to a branch, these two branches in turn successively several times branched, but in a plane at right angles to their own; the lower cells more or less deeply suffused or externally blackened. Receptacle normal, cell II of large diameter. Spores, $40 \times 3.5\,\mu$. Perithecia, $100–110 \times 33–35\,\mu$. Appendages (longest), $150\,\mu$. Total length to tip of perithecium (average), $200\,\mu$.

On *Coptodera Championi* Bates, Panama.

This species does not appear to be very closely allied to any other form known to me. The appendages are not unbroken in any of the specimens, but appear to be decidedly characteristic in their mode of branching. The knob-like tip of the perithecium and the rather abrupt enlargement of the receptacle above the basal cell also render it peculiar in general appearance. The types were found along the outer margin of the hosts' elytra.

Laboulbenia Texana Thaxter. Plate XX, figs. 16–18.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 172.

Perithecium wholly suffused with blackish brown, short, its upper half free, the outer edge abruptly curved inward to the base of the very prominent apex, the lips of which are brown, slightly pointed. Appendages two, hyaline, almost distinct above the very broad black insertion-cell, the outer broad at the base, tapering distally, strongly curved inward, rather closely septate, a small cell opposite each septum on the convex side, bearing a single short simple branch rather closely septate, hyaline, blackened and constricted at the base, directed obliquely upward. The inner appendage similar, except that a cell is present opposite the first septum at the base on the *inner* side, which bears a single antheridium or a very short fertile branch. Receptacle abruptly expanded above cell II, cells I to VI hyaline, the rest blackish brown; cell V greatly enlarged, so as to throw the appendages outward, separating them by nearly its whole width from the perithecium, its free upper surface forming a right angle with the straight inner margin of the perithecium; cells I and II rather slender. Perithecia, $130–150 \times 65\,\mu$. Appendages, $150–160\,\mu$, the branches (longer), $75–100\,\mu$. Length to tip of perithecium, $400\,\mu$. Greatest width, $110\,\mu$.

On *Brachinus* spp., Texas, Guatemala.

One of the most striking of all the species of Laboulbenia, the many peculiarities of which need hardly be pointed out. The tip of the perithecium is not quite so broad in all specimens as it is represented in the figure, but the species seems otherwise very constant. It was found growing on the inferior lateral surface of the prothorax of its host.

Laboulbenia Pachytelis Thaxter. Plate XX, figs. 9–12.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 173.

Perithecium rather small, but slightly exceeding the receptacle, suffused with dark olive-brown, becoming nearly opaque, tapering abruptly to the rather slender blackened tip, which is bent slightly outward, the nearly hyaline lips outwardly oblique. Appendages two: the outer forming a sub-conical body composed of superposed flattened cells four to ten in number, each cell giving rise externally to a single obliquely ascending, rather short, simple, stout, tapering branch, blackened at its base, where a basal cell is cut off by a contrasting black septum. The inner appendage consisting of a small basal and sub-basal cell separated by a blackened septum, the upper giving rise directly to from one to three antheridia or hort sterile branches. Receptacle short or elongate, nearly hyaline or becoming distally suffused with blackish brown, normal, except for the unusual development of cell V, which extends along the inner margin of the perithecium beyond the insertion of the appendages, pushing them outward free from the perithecium. Spores, 66 × 7 μ. Perithecia, 110–150 × 50 μ. Outer appendage, without branches, 90 μ long, the branches (longest), 180 μ. Total length to tip of perithecium, 300–650 μ.

On *Pachyteles mexicanus* Chaud., Mexico.

This striking species is distinguished at once by its outer appendage, which cannot be mistaken for that of any other form. It is rather variable in size as well as in the structure of its receptacle and its relation to the perithecium, which is more commonly that represented in fig. 9. This individual, however, shows an abnormal septation of cell II. Numerous specimens were obtained from the legs and inferior surface of its host.

Laboulbenia Morionis Thaxter. Plate XXI, figs. 19–22.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 169.

Pale straw-colored throughout except for a slight blackish brown shade below the apex of the perithecium. Perithecium small, narrow, its whole inner margin connected with the receptacle, beyond which the rather truncate hyaline tip projects. Appendages inconspicuous, consisting of two basal cells, each of which may bear one to three short branches. Receptacle elongate, slender, expanding but slightly toward its extremity without any abrupt enlargement, the small blackened insertion cell carried outward with the appendages free from the perithecium. Spores, 55 × 5 μ. Appendages, 40–50 μ. Perithecia, 110–125 × 30 μ. Total length to tip of perithecium, 375–425 μ. Greatest width, including perithecium, 50 μ.

On *Morio Georgiæ* Pal., Mexico.

This singular species is distinguished by its narrow habit and small perithecium, which is so closely united to the receptacle and so slightly distinguished from it that it appears at first sight undeveloped. In some specimens the hyaline tips of the lip cells only are free beyond cell V. The appendages are almost obsolete in some instances, and are more reduced than in any other species. It seems undoubtedly allied to the species (*L. Schizogenii* and *L. Clivinæ*) occurring on the allied hosts Clivina and Schizogenius.

Laboulbenia Aspidoglossæ Thaxter. Plate III, figs. 8, 9.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 473.

Perithecium black, almost opaque, rather narrow, the inner margin curved abruptly outward to the rather large apex, the lips very oblique outward. Appendages arising from two basal cells which are nearly equal in size: the outer inflated and separated from the cell above it by a blackened septum, this sub-basal cell roundish, inflated, about as large as the basal cell and giving rise to two branches, an outer and an inner; the outer separated from it by a blackened septum and consisting of a basal cell with three terminal branchlets, the inner of which is deeply and broadly blackened at its base, while the other two are wholly hyaline and fertile; the inner branch from the sub-basal cell has no blackened basal septum and produces several short branchlets bearing numerous antheridia. The inner appendage, like the outer, consists of a roundish or squarish basal cell separated from a sub-basal cell by a blackened septum; the sub-basal cell producing a tuft of short branches bearing at their tips two to four antheridia or becoming more elongate and sterile. Receptacle normal, the two basal cells rather slender, elongate, colorless; the distal cells suffused with blackish brown. Perithecia, 110–120 × 40 μ. Appendages (longest), 240 μ. Total length to tip of perithecium, 333 μ; greatest width, 63 μ.

On *Aspidoglossa subangulata* Chaud., Kansas (M. A. Barber).

A species clearly marked by the peculiarities of its appendages, which, unlike almost all other species of the genus, are fertile without regard to their external or internal origin. In this respect they resemble *L. Clivinæ*, which is found on a closely related host. Otherwise its relationship to other described species is not evident. It occurs rarely on the host mentioned, usually not more than two or three on a given specimen.

Laboulbenia Clivinæ Thaxter. Plate XXI, figs. 16–18.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 169.

Color pale straw-yellow to reddish. Perithecium short, stout, united to the receptacle for three quarters or more of its length; its free portion abruptly tapering to the rather small tip; the lip-cells turned slightly outward, with a blackish suffusion below on the inner side. Appendages united to form a single brush-like organ without any blackened insertion-cell, and consisting of a basal cell which may be single or longitudinally several times divided, followed by a second series of two or more elongate cells placed side by side and bearing distally a series of branches, which, by branching several times successively, form a dense tuft; the ultimate branchlets slender and curved, sterile or fertile. Receptacle moderate, normal, except that cells IV and V become irregularly divided into often numerous (four to eight) cells which vary in form, size, number, and position in different specimens. Spores, 75 × 5 μ. Perithecia, 145–150 × 55–60 μ. Appendage, 110–200 μ. Total length to tip of perithecium (longer), 400 μ.

On *Clivina dentifemorata* Putz., Mexico, and *C. dentipes* Dej., Kansas (Barber).

This species is chiefly remarkable for the union of its appendages at their base into a single body and the abnormal septation of cells IV and V. The appendage is subject to great variation, and in some specimens produces great numbers of antheridia without regard to the

position of the branches. It is evidently related to *L. Schizogenii* and its allies, but cannot be confused with any described species. It appears to be a rare form and occurs scattered here and there on various parts of its host.

LABOULBENIA SCHIZOGENII Thaxter. Plate XXI, figs. 13, 15.

Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 43.

Perithecium blackish brown, deeper below the tip, sometimes nearly opaque, rather short and stout, inwardly inflated and united with the receptacle to its very tip; the hyaline extremities of the lip-cells only free, and bent slightly outward. Appendages arising from a black insertion-cell, consisting of two basal cells, which may be longitudinally several times divided, bearing distally two to several nearly hyaline branches, which may in turn be several times sub-dichotomously branched, the ultimate branchlets flexuous. Receptacle hyaline or straw colored, sometimes distally suffused with brown, bulging outward prominently and evenly in the region of cells III–V; cell V elongated towards the tip of the perithecium, carrying the insertion-cell outward free from the perithecium. Spores, 70 × 5.5 μ. Perithecia, 100–125 × 50–55 μ. Appendages (longer), 270 μ. Total length to tip of perithecium, 350–450 μ.

On *Schizogenius lineolatus* Say, *S. ferrugineus* Putz., and *Clivina cordata* Putz., New England.

This well marked species is quite rare, never occurring in any great abundance on any single host. It is subject to but slight variations, except in the basal cells of its appendages, although small specimens like that represented by fig. 14 sometimes occur. It is most nearly related to *L. Clivinæ*. The hosts are found commonly under stones on the borders of ponds.

LABOULBENIA PHILONTHI Thaxter. Plate XXII, figs. 26–30.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 174.

Perithecium rather narrow, beginning to taper almost from its base to the somewhat coarse-lipped apex, both margins often almost straight. Appendages consisting of two basal cells, the inner producing several (two to five) branches, which arise by successive proliferations on either side, forming two rows running side by side antero-posteriorly: the outer appendage and the branches of the inner erect, simple, rather rigid, tapering considerably, two or three of the lower septa blackened, the cells between them distinctly inflated. Receptacle hyaline or slightly suffused, normal, except that the basal cell is sometimes hoof-shaped, a portion of it blackened and continuous with the foot. Spores, 52 × 4 μ. Perithecia, 160–185 × 50–70 μ. Appendages (longer), 325 μ. Total length to tip of perithecium, 400–450 μ: longest, 590 μ.

On *Philonthus cunctans* Horn, *P. micans* Grav., *P. debilis* Grav., and numerous undetermined species, New England; *P. æqualis* Horn, Lake Superior; *P. furvus* Nord., California.

This species is by no means uncommon on all parts of its hosts, and may be recognized by the peculiar form of its perithecium and the rigid, erect branches of its appendages, the inflated basal cells of which recall those of *L. inflata*. The insertion-cell is not very deeply blackened, and a hyaline pointed portion is more or less distinct between and below the two basal cells of the appendages. The inner of these cells appears to become divided into a num-

ber of cells corresponding to the number of branches which it bears, the partitions running obliquely downward and inward (fig. 27). In some specimens the basal cell of the receptacle is curiously modified in a fashion (fig. 28) similar to that referred to in connection with *Compsomyces verticillatus;* but this hoof-like structure does not appear to be either connected with any special position occupied by the plant or with any peculiarity of the host, and is much less frequent than the normal form. Many species of Philonthus appear to be subject to its attack, whether they occur in moist or dry situations; but the parasite rarely occurs in any great abundance on a single insect. A form allied to this, but in such poor condition that it cannot be described, was found on specimens of *Bledius basalis* Lec., collected in Florida.

Laboulbenia curtipes Thaxter. Plate XVII, figs. 16–19.

Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 40.

Becoming dark olive-brown except the contrasting hyaline basal cell. Perithecium relatively large, stout, inflated; its upper inner margin bulging strongly, the short, flat tip abruptly distinguished, bent slightly outward, the tips of the lip-cells hyaline. Appendages consisting of an outer and inner basal cell not clearly distinguishable, the outer producing several, the inner many branches sub-dichotomously branched, the ultimate branchlets slender, hyaline, somewhat or hardly exceeding the tip of the perithecium. Receptacle short, sub-triangular, distally more or less opaque, the basal cell hyaline. Spores, $40 \times 4\ \mu$. Perithecia, $110–135 \times 55\ \mu$. Appendages (longer), $100–125\ \mu$. Total length to tip of perithecium, $200–225\ \mu$.

On *Bembidium bimaculatum* Kirby, Washington.

This species occurs usually on the posterior legs of its host, and is distinguished by the peculiar form of its perithecium, in which are produced great numbers of spores. The appendages are almost invariably broken, and as no young specimens have been examined, their exact origin at the base has not been made out. The outer basal cell bears a branch terminally and probably laterally on its inner side, while a large number of branches usually arise from the inner cell on either side. The basal cells, as well as the lower cells of the branches proceeding from them, are usually so deeply suffused that the structure is obscured. The base of the trichogyne is often persistent, as in figs. 16 and 18.

This species was obtained in considerable numbers from specimens of its host sent me by Miss A. M. Parker.

Laboulbenia cornuta Thaxter. Plate XIII, figs. 28–30.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 476.

Dark blackish brown. Perithecium tapering to a broad blunt apex, from which projects a prominent straight, dark-brown appendage, unicellular, bent abruptly outward from its base, tapering slightly to its nearly hyaline rounded tip. Appendages as in *L. luxurians*, the branches fewer and stouter. Receptacle short, expanding somewhat abruptly above the sub-basal cell, the basal cell becoming narrowed and nearly hyaline towards its base. Perithecium, $85 \times 29\ \mu$. Its appendage, $26 \times 7\ \mu$. Total length to tip of perithecial appendage, $185\ \mu$; greatest width, $52\ \mu$.

On *Bembidium complanulum* Mann, Washington.

The five types of this singular species are all in poor condition, the appendages being, for the most part, broken; yet it may be recognized without difficulty by the peculiar outgrowth from one of its lip-cells, which distinguishes it from all other species with the exception of *L. Gyrinidarum*, all the lip-cells of which are appendiculate in a somewhat similar fashion. It appears to be peculiar to the single species of Bembidium mentioned, and was found in two instances only on the margin of the right elytron near the base. The outgrowth in all the types proceeds from one of the lip-cells on the right of the pore. The infested beetles were found among material kindly collected for the writer by Miss A. M. Parker.

Laboulbenia fumosa Thaxter. Plate XXII, figs. 9–20.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 12; Saccardo Sylloge, Vol. IX, p. 1132.

Smoky brown with a slight olive tinge. Perithecium becoming almost opaque, tapering rather gradually to the somewhat blunt tip, the lip-cells turned slightly outward. Appendages consisting of two basal cells, the outer followed by a roundish cell which, by successive proliferation on its inner side, gives rise to a number of branches; the first of which, originally terminal, becomes lateral, curved outward, blackened below, and bears several erect, usually simple branchlets. The inner basal cell produces on either side a number of branches, often once or twice branched near the base, nearly straight, erect, tapering; the whole forming a dense tuft. Insertion-cell broad, a hyaline portion projecting up between the two basal cells. Receptacle more or less tinged with brown, paler below, rather stout, never elongate, expanding gradually from below upward. Spores, $55–60 \times 5–5.5\,\mu$. Perithecia, $120–130 \times 50–75\,\mu$. Appendages, $75–100\,\mu$. Total length to tip of perithecium, $250–325\,\mu$; greatest width, $75–100\,\mu$.

On *Platynus cincticollis* Say, New England.

This species is a common one always occurring at the tips of the elytra and extending to the adjacent apex of the abdomen. It is very closely allied to *L. luxurians*, which, curiously enough, grows in exactly the same position on species of *Bembidium*, but is distinguished by its large size and straight appendages. The basal cell of its outer appendage bears a proliferous cell, the first (originally terminal) branch of which becomes pushed outward by its successive proliferation, and the blackened outer half of this branch from which two to four branchlets arise vertically, is quite characteristic in appearance; the branchlets, however, usually breaking off in mature specimens. The next branch found within this primary branch may resemble it to some extent, but is more often simple, like those which succeed it. The species grows densely crowded, and I have never found it on other species of Platynus commonly associated with the one mentioned, which occurs in very wet situations along brooks, where it hides under stones or in wet rubbish. A species very similar to this occurs in the same situation on the elytra of *Anophthalmus tenuis* Horn in Indiana; but my material is hardly sufficient to form the basis of a diagnosis.

Laboulbenia luxurians Peyritsch. Plate XXII, figs. 1–8.

Peyritsch, Sitz. d. Wien. Acad. LXVIII, p. 248, Plate II, figs. 10–16; Sorokin Veg. Parasites, Vol. II, p. 416, Plate XXXII, fig. 762; Winter Pilze Deutsch. II, p. 92; Berlese, Malpighia, III, p. 56; Saccardo Sylloge, Vol. VIII, p. 912.

Smoky olive-brown. Perithecium tapering more or less symmetrically from its lower third to the coarse blunt apex, which is not clearly distinguished from it, one of the lip-cells forming a short but distinct pointed median projection. Appendages formed as in *L. fumosa*, but the ultimate branchlets strongly curved towards and often past the perithecium. Receptacle inconspicuously punctate, stout, the basal cell slender and nearly hyaline below, the sub-basal large, as broad as it is long, separated from cells III and VI by nearly equal oblique septa. Spores about $50 \times 4.5\ \mu$. Perithecia, $110 \times 40\ \mu$. Total length to tip of perithecium, $220\ \mu$.

On *Bembidium varium* Oliv., *B. bipunctatum* Duft., *B. flammulatum* Clairv. Europe. On several species of *Bembidium*, Maine, Connecticut, and Washington.

This small species is not uncommon on Bembidia about ponds and streams, though it is seldom found in great numbers or in very good condition. It grows in a small dense tuft at the tips of the elytra like the preceding species, with which it is closely allied, though readily separated by its curved appendages. The receptacle where it is suffused is rather obscurely punctate.

Laboulbenia compacta Thaxter. Plate XXII, figs. 23–25.

Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 37.

More or less suffused, not deeply, with olive-brown. Perithecium straight, tapering gradually to the rather stout tip, the lip-cells not clearly distinguished, turned slightly outward. Appendages as in the preceding species, the insertion broader, the main branches more numerous, the ultimate branchlets forming a dense tuft, rigid, erect, tapering slightly, hardly equalling the tip of the perithecium. Receptacle short and distally very broad, cells III–V about equal in size. Spores, $60 \times 4\ \mu$. Perithecium, $110 \times 40\ \mu$. Appendages, 90–100 μ. Total length to tip of perithecium, 180–190 μ; greatest width, $65\ \mu$.

On *Bembidium sp.*, Maine and Massachusetts.

This species, though closely allied to *L. luxurians*, seems constant, and is undoubtedly distinct. It may be recognized by its short, stout form and rigid, erect, tapering appendages, which are much more numerous than in its ally. The perithecium and receptacle are also differently shaped and never so deeply colored. It occurs not uncommonly at the base of the posterior pair of legs of its host.

Laboulbenia confusa Thaxter. Plate XXII, figs. 21, 22.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 476.

Becoming deeply suffused with smoky brown. Perithecium rather small, inwardly inflated, the apex broad, slightly oblique outward. Appendages arising primarily from an inner and outer cell: the outer bearing a second cell which bears terminally a dense tuft of hyaline, flexu-

ous, tapering, more or less divergent branches, which are themselves more or less branched; the inner basal cell becoming several times divided and giving rise to numerous branches densely crowded and similar to the external ones. Receptacle consisting of a long sub-cylindrical basal cell, the sub-basal cell shorter and broader, cells III–V unusually large, causing this portion of the receptacle to bulge outward in an evenly rounded and characteristic fashion. Perithecia, 166 × 55 μ. Appendages (longest), 150 μ. Receptacle, 215 μ long, its basal cell 90–110 × 25–40 μ. Total length to tip of perithecium, 315 μ; greatest width, 75 μ.

On *Bembidium sp.*, Connecticut, Washington.

This species, although based on scanty material, seems quite distinct from its nearest allies, *L. luxurians* and *L. compacta*. Although the general arrangement of the appendages is similar in the present species, their flexuous, divergent, tapering habit is quite different from that of the two forms just mentioned, from which it is also distinguished by its larger size and peculiarly shaped receptacle. It occurs on the legs of a very small metallic-green Bembidium.

Laboulbenia minima Thaxter. Plate XXI, figs. 8–11.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 175.

Punctate, suffused with olive-brown, becoming nearly opaque, except the hyaline basal cell. Perithecium becoming rounded in outline, short, nearly straight, the apex broad, truncate, coarse-lipped, distinctly punctate and nearly opaque at maturity. Appendages arising from a rounded base of insertion, composed of several cells and not distinguished from the receptacle, densely clustered, the lower segments nearly hyaline, oval or rounded, with black septa, the ultimate branches cylindrical, hyaline, strongly curved towards the perithecium. Receptacle very short and stout, the basal cell hyaline, the rest nearly opaque and punctate. Spores, 40 3.5 μ. Perithecia, 80 × 40–48 μ. Appendages (longest), 75 μ. Total length to tip of perithecia, 145–150 μ.

On *Callida pallidipennis* Chaud., Panama.

With the exception of *L. Hageni* this is the smallest species of the genus. The perithecium is proportionately large, sometimes very large, as in fig. 8, the distal portion of the receptacle being much reduced. The appendages resemble to some extent those of *L. luxurians*, and their original relations are clearly shown in fig. 10, the inner basal cell producing a row of branches placed antero-posteriorly on either side. The appendages are usually almost entirely broken off as in fig. 8. Abundant material was obtained from the legs and elytra of a specimen of its host in the Museum of Comparative Zoology.

Laboulbenia Quedii Thaxter. Plate XVII, fig. 7.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 167.

Perithecium rather small, straight, suffused with brownish, darker externally just below the apex, the lips turned outward, the outer hyaline, the inner blackened. Outer appendage consisting of a rather large basal cell bearing two branches, the outer strongly curved outward, usually bearing two secondary branches from its basal cell, suffused with blackish; the

inner also similarly branched, the branches long, tapering to a blunt point, often suffused with brown near the base. The inner appendages commonly arise from two basal cells, the inmost smaller and lower in position, each giving rise to a variable number of branches, usually not more than once branched, hyaline except the outer ones, which are larger and usually suffused with brown below. Receptacle elongate. Spores about 55 μ long. Perithecium, $185 \times 50\ \mu$. Longest appendages, 370 μ. Total length to tip of perithecium, 630 μ.

On the upper surface of abdomen of *Quedius vernix* Lec., Illinois.

The material on which this species is based is somewhat scanty, only one of the six specimens being mature. In these the insertion-cell, with one exception, does not become wholly blackened, and seems to give rise on the inner side to a small appendiculate cell. The outmost branch of the outer appendage is deeply suffused with brown and bent outward. The large antheridia, of the ordinary form, are borne terminally or laterally, singly or in pairs, on short branchlets. The form of the perithecium, especially at its tip, is peculiar, but more abundant material is much needed to clearly define the species.

Laboulbenia proliferans Thaxter. Plate XVII, figs. 8–10 and 23.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 168.

Amber brown, often tinged with olive. Perithecium straight, but slightly inflated, amber brown or olive; the tip deeply blackened below the hyaline tips of the lip-cells, which are turned slightly outward. Appendages consisting of an outer and somewhat smaller inner basal cell, the outer producing invariably two branches, one terminal, simple, erect, slightly flexuous; the other external, sub-terminal, outwardly divergent, long, simple, deeply suffused as a rule near its base; its first septum blackened and constricted in many cases. The inner basal cell bears, as a rule, a single long, slender branch on either side, simple or with a short, fertile branchlet at its base; the antheridia terminal in groups of three to five. Within these primary appendages one to three secondary, simple, elongate appendages are produced by the proliferation of as many cells, which become cut off from the upper inner angle of cell V by oblique septa. Receptacle rather elongate, normal, except for the division and proliferation of cell V, which carries the black insertion-cell out free from the perithecium. Spores, $60–70 \times 5.5\ \mu$. Perithecia, 165–170 $\times 55\ \mu$. Longest appendages, 460 μ. Total length to tip of perithecium, 435–540 μ.

On *Eudema tropicum* Hope, Sierra Leone; *Chlænius tenuicollis* Fabr., Syria; *C. velutinus* Duft., Algeria, *Dolichus* (?) sp., Japan.

This species is readily distinguished from all others by the division and proliferation of cell V between the black insertion-cell and the base of the perithecium. In the specimens on *E. tropicum* the external branch of the outer appendage is more sub-terminal and not blackened at its base, and the perithecia are somewhat more inflated, but there can be no doubt as to the identity of the different forms. The Japanese host is doubtfully determined, and is very likely a Chlænius. For the excellent Algerian material I am again indebted to the kindness of Professor Giard.

LABOULBENIA PROLIFERANS Thaxter var. liberiana nov. var. Plate III, fig. 7.

Like the type, but somewhat larger, the basal cell of the outer appendage always bearing a slender external branch blackened at its base. Differing from the type from the fact that the inner accessory appendage, which is usually solitary, is borne on an independent black insertion-cell free above the normal one.

On *Eudema sp. indet.*, Liberia, Africa.

This variety, although its peculiarity just described is constant in the considerable number of specimens which have been examined from different individuals of its host, should not, I think, be separated as a distinct species on so comparatively unimportant a character. Like the other species from this locality, the present variety was obtained from hosts collected by Professor Cook, none of which bore specimens of the normal form.

LABOULBENIA BRACHIATA Thaxter. Plate XXI, figs. 5–7.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 11; Saccardo Sylloge, Vol. IX, p. 1132.

Hyaline or yellowish, becoming more or less deeply suffused with smoky brown. Perithecium somewhat inflated, becoming smoky brown, deeper below the hyaline tips of the lip-cells. Appendages nearly hyaline or in part suffused with smoky brown, arising from numerous small unmodified insertion-cells, corresponding in number, except the outmost, to secondary divisions of cell V, forming an obliquely superposed series from which the appendages arise in a double row, the inner highest and usually somewhat smaller than those lower and outer in the series. Each appendage consisting of a rather large somewhat inflated basal cell, variable in size, which bears usually two branches simple or once branched, the basal cells of each branch or branchlet slightly inflated, the septa oblique and more or less blackened, the ultimate branchlets long, slender, mostly hyaline, somewhat flexuous and attenuated. Receptacle normal, except for the secondary division of cell V, which results in a superposed series of five to seven cells, decreasing in size from below upward, each opposite an insertion-cell; the lowest insertion-cell opposite a small roundish cell just above the extremity of cell IV. Spores, $60 \times 5\,\mu$. Perithecia, $120–150 \times 50–60\,\mu$. Appendages, longer, $700–750\,\mu$. Total length to tip of perithecium, $400–590\,\mu$.

On *Patrobus longicornis* Say, Maine to Virginia; on *P. tenuis* Lec., Hudson's Bay.

This fine and apparently rare species was first taken in the vicinity of New Haven, and later at York, Maine; but has never been obtained in any quantity. A single specimen of its host taken in Virginia by Mr. Pergande as well as several kindly sent me by Dr. Townsend, collected near Eastport, Me., have yielded additional material, while two specimens of *P. tenuis* from Hudson's Bay in the collection of the Museum of Comparative Zoology were also found to be parasitized. It is apparently subject to little variation, and is distinguished at a glance by the regular secondary division of cell V, which is found in no other species with the exception of *L. fasciculata* Peyr., although an approach to this condition is seen in *L. proliferans*. The antheridia are proportionately very small, and are borne usually in pairs, terminally on short one-celled branchlets (fig. 6). Whether or not the present species should be kept distinct from *L*

fasciculata it is impossible to say until we have more definite and reliable information concerning Peyritsch's species; but although his description is quite worthless, the two could not be united if one can trust his figures, by reason of the wholly different form of the appendages.

LABOULBENIA FASCICULATA Peyritsch.

Sitz. d. Wien. Acad. Vol. LXVIII, p. 248, Plate I, figs. 8–9; Sorokin, Veg. Paras. Vol. II, p. 416, Plate XXXII, fig. 757; Winter Pilze Deutsch. II, p. 922; Berlese Malpighia, III, p. 56; Saccardo Sylloge, Vol. VIII, p. 911.

"Pale yellowish brown. Appendages numerous, clustered, superposed, colorless, about as long as the perithecium." Length, 370 μ.

On *Chlænius vestitus* F., Austria.

This species corresponds essentially in structure to the preceding, except that the appendages appear to be different in character and much shorter. As already mentioned, the two may prove to be identical. A single immature example of what appears to be the same form was found on a European specimen of *Omophron limbatum* F., but is not sufficiently perfect either to figure or describe.

LABOULBENIA ARMILLARIS Berlese.

Malpighia, Vol. III, p. 52 (1889), Plate II, figs. 1–6; Saccardo Sylloge, Vol. VIII, p. 911.

"Pale brownish; with a clavulate stipe, bicellular below, above composed of a number of cells disposed in two longitudinal series, the one bearing the perithecium two-celled, rather short, the other four to six-celled, bearing the pseudoparaphyses, attenuated at its base and terminating in a black, opaque, coriaceous obconical piece, 21 × 14 μ, adhering very firmly to the host by its pointed base, 100 μ long, pale yellowish, filled with granular protoplasm; perithecium subcylindrical or long-ovoid, brown, terminated by a black neck furnished with a pore and a black appendage, having a few black rings, at its apex, 110 × 36–40 μ; pseudoparaphyses dichotomous or laterally almost sympodially branched, terminated by two branchlets pointed at their tips and resembling the claw of a scorpion, divided at the base of the branches by black rings or discs rather thick and coriaceous, very pale yellowish, extending to the tip of the perithecium.

"On *Antennophorus caputcarabis*, Paraguay. Total length, 290–320 × 36–40 μ."

The above description is quoted from the paper of Berlese cited, since the species is unknown to me. As far as can be determined from the published figure and description the species would seem to be related to *L. variabilis* through the multicellular insertion of its appendages. The blackened septa of the latter can hardly be considered very distinctive since they occur in numerous species and the furcate terminal branchlets may very probably be antheridia. The "appendage" below the tip of the perithecium on the inner side is undoubtedly the old base of the trichogyne (cf. Pl. XXI, fig. 12).

The chief interest of the species lies in the fact that it is the only form known to be parasitic on one of the Acarini.

LABOULBENIA VARIABILIS Thaxter. Plate XXI, figs. 1–4.

Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 38.

Nearly hyaline or suffused, sometimes deeply, with smoky brown. Perithecium straight and rather narrow, or stout and inflated; hyaline or deep smoky-brown, blackened deeply below the hyaline tips of the lip-cells, which are rather coarse and turned slightly outward or nearly straight. Appendages numerous, arising from as many small cells, which take the place of the ordinary insertion-cell, several times sub-dichotomously branched, the lower three or four septa blackened and oblique, the cells between them inflated, the ultimate branchlets straight, tapering, rather slender, erect or slightly divergent. Antheridia borne on short branchlets about the lower portion of the appendages, forming a conical cluster and arising laterally as well as terminally in variable numbers. Receptacle normal, except that cells IV and V may be distally and irregularly divided into a few small cells; short and stout or very elongate, hyaline or wholly or partly suffused with smoky brown, the darker portions punctate. Perithecia, 100 × 225–35 × 125 μ. Appendages, longest, 475–500 μ. Total length to tip of perithecium, 180 μ to 1.65 mm. Spores, 50–75 × 6–7 μ.

On *Anomoglossus pusillus* Say, *Chlænius æstivus* Say, *C. cumatilis* Lec., *C. cursor* Chev., *C. leucoscelis* Chaud., *C. floridanus* Horn, *C. pennsylvanicus* Say, *C. ruficauda* Chaud., *C. sparsus* Lec., *C. texanus* Horn, *C. tricolor* Dej., *C. viridicollis* Reiche, *Omophron americanum* Dej., *Omophron* spp. indet., *Nebria pallipes* Say, *Pterostichus adoxus* Say, *P. luctuosus* Dej., *P. corvinus* Dej., *P. caudicalis* Say, *P. Sayi* Brullé, *Patrobus longicornis* Say, *Platynus extensicollis* Say, Maine to Florida and Texas, Utah, Nebraska, Washington, California, and Mexico. On *Pterostichus* (?) sp., Brazil.

This species is remarkable for its great variation in size, even on the same host: specimens on *Pterostichus caudicalis* measuring over a millimeter and a half, while many individuals on Omophron are less than 200 μ in length. The form and relative position of the perithecium also differs very considerably, and in one instance the tip of the perithecium scarcely exceeds cell V, being united to the receptacle throughout its length. Although their number and length varies very greatly, the species is always readily recognized by the character of the appendages and their insertion on an irregularly cellular base, which is made up partly from divisions of an original single insertion-cell and irregular terminal divisions of cells IV and V. It is a common form, occurring on all parts of its hosts, though preferring definite positions in certain cases, as for example in *Pterostichus luctuosus*, where it is usually found along the edges of the elytra, especially the left near the base. It grows usually scattered, but often rather closely crowded. It is more closely connected with the aquatic forms than any other species, unless perhaps *L. armillaris*, through the irregularity of the cells which form the base of insertion of its appendages, and affords a connecting link which renders the exclusion from the genus of the first mentioned forms quite unwarrantable unless they may prove to present essential variations in their sexual processes.

The material from South America, which was obtained from specimens of a Brazilian *Pterostichus* (?) in the Museum of Comparative Zoology, was found on the legs and on the lower surface of the thorax of the host, and although some of the specimens are peculiar in habit,

probably as a result of the position of growth, there seem to be no essential differences between this and the type forms.

LABOULBENIA OBERTHURI Giard. Plate XXII, fig. 39.

Thaxter, Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 477.

Nearly hyaline except the brown or smoke-colored perithecium and sub-basal cell of the receptacle. Perithecium large, inflated towards the base, the narrower distal half abruptly rounded and contracted below a rather narrow apex with protruding lips bent outward; general color dark brown, much deeper below the apex. Appendages numerous, crowded, slender, short, the lower segments inflated, arising as in *L. Guerinii*. Receptacle elongate, consisting of a short curved stout nearly hyaline basal cell, a very long sub-cylindrical sub-basal cell, smoky brown in color, with deeper brown wart-like or scale-like scattered prominences of varying size, the remaining cells normal except that the insertion-cells of the appendages are irregularly divided. Perithecium, 300–315 × 120 μ. Receptacle, 1 mm.–900 μ; its sub-basal cell 370–425 × 65–75 μ. Total length to tip of receptacle, 1.225 mm.

On *Orectogyrus heros* Reg., Madagascar.

This fine species was kindly communicated to the writer by Professor Giard, who dedicated it to M. René Oberthur, its discoverer. It is one of the largest species of the genus, its dimensions being exceeded only by *L. Kunkeli*, *L. palmella*, and the largest forms of *L. variabilis*. Although closely allied to *L. Guerinii* it is abundantly distinct and recognizable at a glance by its peculiarly modified sub-basal cell. The appendages are for the most part broken in the three specimens which constitute the types, and in more perfect examples may prove to be more highly developed than is indicated in the figure. It will be noticed that the latter is drawn with a somewhat lower combination than the other figures of the plate.

LABOULBENIA ORECTOGYRI nov. sp. Plate IV, fig. 5.

Perithecium blackish brown, nearly opaque, rather short and stout, curved, the apex well defined, the lip-cells irregularly prominent. Receptacle long and rather slender, cells I and II much elongated, the former deeply suffused distally, the latter brownish but translucent, the remainder deeply suffused or quite opaque. Appendages numerous in a rather dense tuft, arising as in other aquatic species; hyaline, short, sparingly branched, constricted at the somewhat suffused septa. Perithecia, 140 × 50 μ. Receptacle, 450 μ. Total length, 575 μ. Appendages (longest), 45 μ. Spores (measured in perithecium) about 50 μ.

On *Orectogyros Bedeli* Reg., Bopora, Liberia, Africa (O. F. Cook).

The several types of this form include but a single mature specimen, so that it is uncertain whether the coloration described or the very abrupt curvature of the perithecium are constant characters. The younger specimens, however, are sufficient to show that the appendages are unlike those of either of the other aquatic Laboulbeniæ. The species is most nearly related to *L. Guerinii*, from which it differs in its more numerous and slender appendages as well as in its general form. With the Madagascar species (*L. Oberthuri*), which occurs on a similar host,

it cannot be by any possibility confused. The five types were found along the margins of the abdomen beyond the tips of the elytra.

Laboulbenia Guerinii Robin. Plate XXII, fig. 38.

Robin Hist. Nat. d. Veg. Par. p. 64. Plate X, figs. 1–3; Peyritsch Sitz. d. Wien. Acad. Vol. LXVIII, p. 247. Sorokin, Veg. Paras. Vol. II, p. 413, Plate XXXIII, fig. 780; Winter Die Pilze Deutsch. II, p. 921; Berlese Malpighia, Vol. III, p. 54; Saccardo Sylloge Fung. Vol. VIII, p. 910; Thaxter, Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 176.

Becoming more or less suffused with smoky brown. Perithecium becoming almost opaque, slightly inflated below, its upper half tapering evenly to the blunt apex, the lip-cells straight, the inner forming a slight prominence. Appendages rather numerous, not equalling the tip of the perithecium, once or twice branched; the lower septa blackened, the intervening cells slightly inflated, the insertion-cell apparently divided into several cells which are opaque and indistinguishable. Receptacle distally rather deeply suffused, the basal and sub-basal cells hyaline or translucent, normal, except that cells IV and V may be distally divided into a few small secondary cells. Perithecia, 110 × 55 μ. Appendages, 55 μ. Total length to tip of perithecium, 300 μ. Robin's measurements are, — perithecia, 121 × 45 μ; appendages, 30–55 μ; total length, 430 μ; greatest breadth, 80 μ.

On *Gyretes sericeus* Laboulb., Caracas, Venezuela; on *G. compressus* Lec. (= *G. sinuatus* Lec.) Texas and Illinois.

The North American specimens of this species differ from Robin's account only in their somewhat shorter, stouter habit, which is doubtless due to the fact that they live on a smaller host. The original figures represent slight differences in the appendages, which may well be due to careless reproduction. In other respects the two forms correspond so closely that their identity seems very probable; although more abundant material of both is much to be desired. The species is closely allied to *L. Orectogyri*, as above mentioned, and together with the two preceding and the following species forms a well-marked type within the genus.

The present species occurs, like *L. Guerinii*, along the margins of the elytra of its aquatic host.

Laboulbenia Gyrinidarum Thaxter. Plate XXII, figs. 31–37.

Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 39.

Blackish brown, becoming nearly or quite opaque. Perithecium large, sub-conical or sub-cylindrical, straight, the lip-cells nearly symmetrical, hyaline tipped, each producing a terminal, short, straight, tapering, finger-like, converging outgrowth; often wholly or partly aborted. Appendages hyaline or becoming brownish below, arising in a broad dense tuft from an opaque base, several times irregularly branched, rather closely septate below and constricted at the blackened, often oblique, septa, the cells between which are more or less inflated, the ultimate branchlets slender, hyaline, sub-erect, rarely equalling the tip of the perithecium. Receptacle distally very broad, opaque, abruptly expanded above cell II, cell I usually curved and slender and sometimes elongate. Spores, 90 × 7–8 μ. Perithecia, 190 × 90 μ. Appendages, longer, 100–150 μ. Total length to tip of perithecium, average, 375 μ; longer, 480 μ; greatest breadth, 160 μ.

On *Gyrinus fraternus* Coup, and several undetermined species, New England; on *G. affinis* Aube, and *G. ventralis* Kirby, Middle States; on *G. analis* Say, Missouri; on *G. confinis* Lec., Oregon; on *G. consobrinus* Lec., and *G. plicifer* Lec., California; on *G. urinator* Illig., France.

This remarkable species is by no means uncommon, and is so peculiar that it could by no chance be confused with any other species. A comparison of its younger stages shows that it corresponds in all essentials to the type structure of the genus, there being primarily a single insertion-cell above cells IV and V, which are normally placed (figs. 32–34), while the appendages are developed originally from an inner and outer basal cell (fig. 34), as in species of the usual type. The outer appendage consists at first merely of two or three roundish superposed cells, terminally more or less bilobed, from which a certain number of branchlets may arise; while the primary basal cell of the inner appendage by constant and successive division and proliferation forms the broad base of insertion characteristic of the mature plant. How far cells IV and V and the insertion-cell take part in forming this base through secondary divisions, the opacity of the plant in this region renders uncertain. Cells I and II are sometimes quite elongate and very slender; but as a rule the general habit is such as is represented in fig. 31. The outgrowths from the lip-cells are similar in a way to those occurring in *Stigmatomyces virescens*. They are often irregular in form and frequently are but partially developed. *L. cornuta* is the only other species of the genus having a somewhat similar outgrowth from one only of its lip-cells.

The trichogyne is highly developed (fig. 36) and peculiarly branched; its terminal branchlets tending to grow sideways in between the bases of the appendages. I have thus far been unable to determine the character of the antheridia in this species, and have even been led to suspect that the antherozoids might be exogenous. It is quite uncertain, however, what their nature really is.

The species occurs along the outer margins of both elytra of its host, sometimes extending to the free tip of the abdomen, often growing in dense tufts. The latter, like all the other aquatic forms infested by members of the present genus, is one which swims on the surface of the water, and is very common in ponds and ditches, or along the margins of streams.

TERATOMYCES Thaxter. Plate X, figs. 1–17; Plate II, fig. 1.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 182; Vol. XXIX, p. 98.

Receptacle consisting of three superposed cells surmounted by a more or less cup-shaped terminal portion divided by vertical and oblique septa into a series of numerous small cells arranged peripherally, from which arise numerous appendages which completely surround the point of origin of the perithecia. Perithecia one to several (five), symmetrical, with single stalk-cells. Appendages consisting of a short series of sympodial branches, bearing sympodial branchlets directed outward, many terminating in sharply-pointed, beak-like, sterile, terminal cells. Antheridia flask-shaped or beak-like cells, free from one another, superposed in a single vertical external row arising from the lower segments of the appendages. Trichogynes copiously branched and septate. Spores once-septate.

This genus presents one of the most curious and clearly defined types among the Laboulbeniaceæ, and although the succeeding genus Diplomyces is evidently its nearest ally, its immediate relations to other genera are very obscure. Owing to the early multiplication of appendiculate cells, the relation of the appendages to the points of origin of the perithecia have not been determined. The exact process by which the terminal series of cells is formed is also not clear. This series does not have the same appearance from all sides, and it appears to be produced as a result of the successive separation of the cells which form it, through the proliferation of the receptacle to the right and left of a common centre within which the perithecia arise. The appendages are unlike those of any other genus, and result from the formation of successive sympodial branches, which are formed in a vertical radial plane. When young they bear the antheridia usually near the base, sometimes alternating irregularly with prominent beak-like branchlets of characteristic appearance, the two forming a single external vertical series (Plate X, figs. 6 and 11). The trichogynes are often very highly developed, varying greatly in their luxuriance in different specimens of the same species. In some cases they are not unlike the appendages in general appearance, the form and mode of branching of their terminal portions being very similar; although in *T. Actobii* there is a very distinct and characteristic modification of the receptive tips of their ultimate branchlets (fig. 17). Fig. 1, Plate II, represents another instance of a highly developed female organ. The perithecia have but four wall-cells in each row, and appear to contain but two ascogenic cells. The species all occur on beetles belonging to the Staphylinidæ, which are found in very wet situations.

TERATOMYCES MIRIFICUS Thaxter. Plate I, fig. 1; Plate X, figs. 4–7.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 182.

Perithecia one to three, pale, becoming reddish or purplish brown, straight, basally inflated, distally sub-cylindrical; tapering abruptly to a symmetrical truncate apex, the stalk-cell cylindrical, often very elongate. Receptacle somewhat flattened, consisting of a small narrow basal cell, brown but more or less translucent; a larger sub-basal cell, which bulges abruptly on one side and is almost wholly opaque except along this prominence: while the distal of its three cells is hyaline, becoming reddish brown, very variable in length, sometimes much longer than the basal and sub-basal cells together. The larger appendages consist of a single long slender flat reddish-brown basal cell, bearing very numerous antheridia or sterile beak-like branchlets in a single vertical row, the terminal branches larger and themselves one to three times branched, the ultimate branchlets often obliquely septate, the septa dark or terminating in pointed beak-like cells. Spores, $40 \times 4\,\mu$. Perithecia, $128–140 \times 22–26\,\mu$. Stalk (longest), $480\,\mu$. Appendages (longest), $185\,\mu$. Receptacle, $110–180\,\mu$, greatest width about $45\,\mu$. Total length to tip of perithecium, $220–750\,\mu$.

On *Acylophorus pronus* Er., Maine and Massachusetts; *A. flavicollis* Sachs., Pennsylvania and Kansas. *A. flavipes* Lec., Florida.

The specimens of this singular species, which were found on the abdomen of *A. flavipes* from Florida, differ from those on the other hosts in their much smaller size, and are not more than half as large as the ordinary form. Yet there seems to be no doubt concerning their identity.

The species is at once distinguished from any of the others by the curious one-sided bulge of the sub-basal cell of its receptacle, which is of course not visible unless the latter lies sidewise. There is great variability in the length and luxuriance of the appendages, which are usually much broken, and in the length of the stalk-cell of the perithecium, which, in mature specimens, is usually several times as long as the perithecium. The third cell of the receptacle is also very variable in length, sometimes decidedly elongate, more commonly short and stout.

The species is usually conspicuous and easily seen at the tip of the abdomen of its host, where it more often occurs in small groups, although it may not infrequently be found on the legs and other portions of the insect. The host *A. pronus* is very common in early summer at the margins of ponds and ditches, hiding in wet moss and rubbish.

Teratomyces Quedianus nov. sp. Plate X, fig. 8.

Closely allied to the preceding species. Perithecium larger, sub-cylindrical or very slightly inflated, terminated abruptly by a sub-cylindrical or slightly tapering, bluntly rounded apex. Receptacle elongate, the sub-basal cell long, tapering below and wholly opaque, the blackening involving the base of the cell above it, which is distinctly constricted below the terminal cellular portion. Appendages as in *T. mirificus* much shorter and more thickly beset with brown sharply pointed septate branchlets. Spores, 50–55 × 4.5 μ. Perithecium, 155 × 30 μ. Appendages, longest 150 μ. Receptacle, 160 – 165 μ. Total length to tip of perithecium, 450 μ.

On *Quedius ferox* Lec., Cambridge, Mass.

Fourteen individuals of this form were found on a specimen of its host collected in April, among leaves in swampy woods about Fresh Pond. The species, though very close to *T. mirificus*, seems constant in its differences, and is easily distinguished by the structure of its receptacle, which lacks the prominence peculiar to the last-mentioned species, as well as by the different form of the tip of its perithecium. But two of the specimens are fully mature, and more abundant material would doubtless show much greater range in size than is indicated by the measurements given above.

Teratomyces Actobii Thaxter. Plate X, figs. 9–17.

Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 98.

Perithecia one to four, reddish brown, distinctly inflated towards the base, the distal portion symmetrically conical, tapering to a blunt apex; borne on a single short stalk-cell not exceeding the appendages in length, followed by three rather large basal cells disposed as in *T. mirificus*. Receptacle short, nearly symmetrical, tinged with brownish or nearly hyaline, consisting of three superposed cells, the basal small and narrow, the sub-basal squarish, sometimes partly or wholly opaque, the distal large, rounded, and followed by the series of small cells from which arise the numerous appendages which in general resemble those of *T. mirificus*, though proportionately stouter and more intricately branched. Spores, 26 × 3.7 μ. Perithecia, 120–137 × 37 μ. Stalk-cells, 75–100 μ. Longest appendages, 150 μ. Three basal cells of receptacle, 37 × 22 μ.

On *Actobius nanus* Horn., Kittery Point, Maine; Arlington, Mass.

This species occurs with the next on the legs of its host, less frequently on the thorax or abdomen. It differs from *T. mirificus* in the form of its perithecia, which are sub-conical, as well as by its symmetrical receptacle. The short stalk-cell and large basal cells of its perithecia serve also to distinguish it.

Teratomyces brevicaulis Thaxter. Plate X, figs. 1–3.

Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 99.

Perithecia one to five, purplish brown, long, slender, straight or slightly curved, cylindrical or slightly inflated near the middle, tapering abruptly to the almost truncate apex, much longer than the stalk and basal cells together, the latter concolorous with the perithecium, the stalk-cell nearly hyaline. Receptacle nearly symmetrical, black and quite opaque, except the partly translucent basal cell; above the opaque portion expanding abruptly to form the broad distal portion, from the numerous small cells of which arise, around the edge, the circle of crowded appendages which surround the perithecia. Larger appendages faintly tinged with brownish purple, consisting of a rather short stout basal cell bearing below, externally, several antheridia and short simple pointed branchlets, above one to several large branches, which in turn branch near their distal ends one to three times successively in the same plane, the basal cells of the branches and primary branchlets usually distally inflated, the ultimate branchlets obliquely septate and blunt, or more often ending in a sharply pointed cell. Spores, $33 \times 4\ \mu$. Perithecia, $110–120 \times 23\ \mu$. Stalk-cells, $50 \times 15\ \mu$. Receptacle, $85 \times 50\ \mu$. Longest appendages, $100\ \mu$.

On *Actobius nanus* Horn, Kittery Point, Maine, and vicinity of Cambridge, Mass.

This species is much rarer than the preceding, which is sometimes associated with it on the abdomen of its host. It is subject to considerable variation in size and in the length of its appendages, but is always readily distinguished by the form of its short-stalked perithecia and the peculiar more or less clavate form of the larger cells of its appendages. The host occurs with *Acylophorus pronus*, but is less common.

DIPLOMYCES Thaxter. Plate X, figs. 18–21.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 468.

Flattened antero-posteriorly, sub-triangular, bilaterally symmetrical, furcate through the presence of a pair of prominent posterior projections. The receptacle consisting of two superposed cells, followed by four cells placed antero-posteriorly in pairs, of which the posterior produce the characteristic prominences; the anterior a pair of short stalked perithecia, near the base of which, within and above, arise two or more pairs of appendages, and eventually a second pair of perithecia. Appendages copiously branched, many of the branchlets terminated by beak-like cells. Spores once-septate.

A singular genus, recalling Teratomyces, to which it seems most nearly allied through the presence of the characteristic terminal beak-like cells of its appendages. The branching of the latter is not, however, sympodial in a single plane, as is the case in Teratomyces, and the general structure of the receptacle is difficult to homologize with that of any other genus. The

second pair of perithecia arise in all probability from secondary divisions of the pair of perithecia-bearing cells above described; but the exact structure in this region, behind the stalk-cells of the perithecia, has not been made out satisfactorily. An obliquity in the septum which separates the basal and sub-basal cells sometimes results in the apparent absence of any sub-basal cell.

Diplomyces Actobianus Thaxter. Plate X, figs. 18–21.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 469.

More or less faintly tinged with brownish. Basal cell of receptacle triangular, sub-basal cell flattened or wedge-shaped; the posterior prominences peculiar to the genus nearly as long as the receptacle itself, slightly divergent, two-celled, the terminal cell twice as long as the basal, tapering slightly towards its rounded extremity. On the anterior side the two perithecigerous cells bear the first pair of perithecia on short stalk-cells bent abruptly upward, divergent, and succeeded by three small cells forming the base of the perithecium. The perithecia rather slender, curved towards the receptacle, so that their tips project beyond it, divergent, rather long and slender, tapering slightly, the apex blunt with ill defined lips, the base of the old trichogyne persisting conspicuously below the pore. Appendages branching, arranged in pairs symmetrically like the perithecia; a smaller one arising just behind the stalk-cell of the perithecium, a much larger one above this followed by a few smaller ones less definitely arranged in the region whence a second pair of perithecia may arise. All the appendages more or less copiously branched, the branchlets terminating in many cases by the slender, curved, and sharply pointed cells characteristic of Teratomyces. Spores, $32 \times 2\,\mu$. Perithecia, including stalks, about $75 \times 12\,\mu$. Receptacle to tips of prominences, $75\,\mu$. Total length to tip of perithecia, $110\,\mu$. Greatest width, $37\,\mu$.

On *Actobius nanus* Horn, Massachusetts.

This species occurs rather rarely on the abdomen of a large brown variety of *Actobius nanus*, but not as far as has been observed on the normal form. A second species, perhaps distinct from the present, was found on the abdomen of a small Philonthus, and is distinguished by the presence of slender thread-like branches from the larger appendages. Sufficient material of this form was not, however, obtained, and it may prove to be nothing more than a variety of the one above described.

RHACHOMYCES Thaxter. Plates II, IV, X–XII.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 468; *Acanthomyces* Thaxter (nec Lebert), l. c. Vol. XXVII, p. 36.

Receptacle consisting of a single basal cell surmounted by a more or less elongated body composed on one side of a primary series of superposed nearly equal cells; on the opposite side of a second series, of smaller and more numerous cells bearing large numbers of bristle-like appendages, extending up to and more or less surrounding the base of the perithecium. Perithecia produced laterally near the tip of the receptacle, at maturity apparently terminal, stalked or nearly sessile, symmetrical. Spores once-septate. Antheridial cells single, terminal on short stalks.

This well-defined and characteristic genus was first described by me under the name Acanthomyces, in ignorance of the fact that it had already been used by Lebert in a zoological paper (Zeitschrift für Wissenschaftliche Zoologie, 1858, Vol. IX., p. 447) for an entomogenous fungus probably identical with *Isaria sphingum*. The name Rhachomyces has been substituted as suggesting the resemblance which the main axis of the plant bears to a vertebral column, a resemblance sometimes made more striking by the presence of a sigmoid curve (Plate XII, fig. 6).

The eight species which compose the genus are very constant in their essential characters, and vary chiefly as regards the number of cells composing the main axis of the receptacle, and in the number and length of the appendages. Extremes in these respects are represented by the two species *R. pilosellus* (Plate XII, figs. 12–13) and *R. longissimus* (fig. 4). I have been unable to obtain a series of young specimens to illustrate the complete development of the main axis of the receptacle; but from the specimens available it is evident that the main body of the latter arises as a lateral outgrowth, somewhat in the same manner and in the same position that the perithecium of genera like Laboulbenia or Stigmatomyces originates. The youngest condition observed consists of a simple series of superposed cells, the terminal portion of which, all above the sub-basal cell, becoming blackened and modified to form the lowest member of the series of appendages, which are characteristic of all the species of this genus. It is then as an outgrowth from the sub-basal cell that all the remainder of the plant is developed. The first indication of this development is seen in fig. 10, Plate XII, in which an oblique partition has divided the sub-basal cell into an upper and a lower portion, and it is from the subsequent divisions of this upper portion that the body of the receptacle, including the male and female organs, arises. The axis, as in so many other instances among the Laboulbeniaceæ, more especially in the case of their appendages, seems to consist in reality of a series of sympodial branches, while the appendages and antheridial branchlets arise from small cells, which become laterally separated on one side. The appendages are arranged in two vertical rows throughout the greater portion of the axis, thus succeeding one another in pairs as a rule; and between them and for the most part wholly concealed by them are borne sterile or antheridial branchlets; the latter, so far as known, also produced in pairs, appressed in habit, each bearing a single terminal, flask-shaped antheridium of the usual form (figs. 18–19). The perithecium seems to arise from one of the sub-terminal cells of the main axis between the appendages, which may at maturity be present around its base. The terminal portion of the axis often extends normally some distance beyond the base of the perithecium, as in *R. furcatus*; while in other cases it may be very short, as in *R. lasiophorus*; and it is from this portion that the proliferation described below takes place.

The receptacle normally bears but a single perithecium, but in exceptional cases two may be formed side by side from the same cell (Plate X, fig. 22). When, however, the trichogyne has for any reason failed to become fertilized, or the perithecium which was first formed is injured or becomes infertile, a terminal proliferation of the axis takes place, and from this proliferation is produced sub-terminally a second perithecium, as in fig. 2, Plate XII. This process may be once or even twice repeated, as in fig. 14; but in any case the phenomenon is not to be considered a normal occurrence. It may be mentioned as a curious fact that the number of cells which compose one of these proliferations in a given species seems to be more or less constant, as indicated in the figure last cited.

The perithecium is but slightly flattened, its cell-rows composed of four cells, and contains four ascogenic cells at maturity. The trichogyne, which has been observed in a few instances, is rather short and sparingly branched and septate (Plate II, fig. 6). The sterile appendages are very characteristic in appearance, being invariably simple, usually quite opaque, except along their upper margin, and more or less distinctly septate.

The species occur on beetles belonging to the Carabidæ and Staphylinidæ, two of them on cave beetles, and are found in Europe, Africa, and North America, including Mexico.

RHACHOMYCES LASIOPHORUS Thaxter. Plate II, fig. 6; Plate XII, figs. 7–11 and 17–19.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 467; *Acanthomyces lasiophorus* Thaxter l. c. Vol. XXVII, p. 37.

More or less suffused with blackish brown. Perithecium sessile, becoming brown, somewhat inflated, nearly symmetrical, tapering to a rather blunt apex. Appendages arranged in two rows of larger bristle-like members, hyaline-tipped, blackish below, running from the sub-basal cell to the apex of the receptacle, where they surround the base of the perithecium, which exceeds them by about half or one-third its length: from the cells of the receptacle between these two rows arise smaller appendages, which become more numerous towards its extremity. Receptacle slender at the base, expanding upward, consisting of a main axis of about twelve superposed vertebra-like cells, at first hyaline, becoming blackish, and of a series of smaller cells almost completely concealed by the appendages. Spores, $30 \times 3\,\mu$. Perithecia, $140–145 \times 50\,\mu$. Larger appendages, $75–90\,\mu$. Receptacle, $175\,\mu$.

On *Atranus pubescens* Dej. New Hartford, Connecticut; Stony Brook, Mass.; Virginia. On *Badister micans* Lec., *Acupalpus carus* Lec., and *gen. indet.*, Kittery Point, Maine.

A few specimens of a species apparently identical with this were found on a small species of Platynus captured in swampy woods at Kittery, but these as well as the host have been unluckily lost. The usual host of the species is quite rare, and I have found but four specimens, two of which were infested. The Virginia specimens were collected near Washington by Mr. Pergande. The compact form, brown inflated perithecium, short, stout, and closely appressed appendages serve to distinguish the species from its allies.

Within the past year further material of this form has been collected at Kittery on the two additional hosts above mentioned, from which it is apparent that the species is subject to considerable variations in size and form. Figures 17–19 of Plate XII were drawn from this material, and fig. 17 represents the greatest divergence from the type observed in any of the mature individuals.

RHACHOMYCES SPELUNCALIS Thaxter. Plate XI, figs. 23–25.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 468.

Perithecium more or less deeply suffused with brown; short and stout, with a broad, bluntly rounded apex. Receptacle slender, the main axis constricted strongly at the septa, its cells rather small, the basal slender and cylindrical; the remainder, about nine in number, all evenly and rather deeply suffused with brown, and more or less uniform in size. Appendages mostly

opaque, more or less rigid, hyaline-tipped, those surrounding the base of the perithecium hardly equalling it in length, a few lower on the receptacle exceeding its apex by the whole length of the plant; of the shorter median appendages some are terminated by a peculiarly modified, partly hyaline antheridial cell, the neck-like tip of which curves strongly outward, terminating bluntly. Perithecia, 90 × 37 μ. Receptacle about 110 μ (when not proliferous). Longest appendages, 300 μ. Total length to tip of perithecium, 185 μ to 260 μ (in proliferous forms).

On *Anophthalmus pusio* Horn, West Virginia.

The smallest species of the genus, more nearly allied to *R. lasiophorus* in the form of its perithecium and the disposition of its appendages around the base of the latter, but differing in its slender form, longer and more slender appendages and irregularly constricted receptacle. A small number of specimens were found growing near the tips of the elytra of its host, a blind cave beetle. The curved cells borne on short branches (fig. 25) are conspicuous in some specimens, and are undoubtedly antheridia.

RHACHOMYCES LONGISSIMUS Thaxter. Plate XII, fig. 4–5.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 467; *Acanthomyces longissimus* Thaxter l. c. Vol. XXVIII, p. 176.

Perithecium brown, darker at the blunt apex, slightly inflated, its two lower thirds almost completely surrounded by a series of appendages arising from its base. Receptacle very long and slender, slightly flexuous, its main axis consisting of about thirty superposed cells deeply suffused with blackish brown, lighter at the septa. Appendages very numerous, externally opaque, internally more or less hyaline, short, slender, straight, appressed; a few curved, projecting outward on either side in successive pairs. Spores, 60 × 4 μ. Perithecia, 185 × 55 μ. Appendages about 110 μ long, those at the base of the perithecium about 165 μ. Receptacle slightly exceeding a millimeter in length by 30 μ broad.

On *Colpodes evanescens* Bates, Guatemala.

One of the largest of all the Laboulbeniaceæ found on the elytra of a small Colpodes in the collection of the Museum at Cambridge. Apart from its great size it is readily distinguished by the curious disposition in pairs of certain of its slender appendages.

RHACHOMYCES HYPOGÆUS Thaxter. Plate XII, fig. 6.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 467. *Acanthomyces hypogæus* Thaxter l. c. Vol. XXVIII, p. 177.

Perithecium nearly sessile, terminal, pale straw-colored, hardly inflated, continuing the sigmoid curve of the receptacle, its blunt apex exceeding the tips of the appendages by about half its length. Receptacle uniformly pale straw-colored, bent in a sigmoid curve, the base slender, the remaining portion stout, the main axis consisting of about eighteen superposed cells with very oblique septa, the appendiculate cells unusually large, their bases externally distinct. Appendages numerous, closely set, appressed, slightly curved inward, deep brown, the tips paler. Perithecium, 145 × 37 μ. Appendages, 110–150 μ. Receptacle, 340 × 37 μ.

On *Anophthalmus Bilimeki* Sturm., Carniolia, Austria.

One mature and several immature specimens of this fine species were found on the elytra of a specimen of its host in the collection of the Cambridge Museum. It is at once distinguished by its sigmoid outline, colorless receptacle, and appressed, incurved, short appendages, as well as by the unusual development of its appendiculate cells.

RHACHOMYCES ARBUSCULUS nov. sp. Plate IV, figs. 6–7.

Perithecium pale straw-colored, long and slender, tapering slightly and gradually towards the bluntly rounded apex, which is suffused with brown; the stalk-cell short, for the most part hidden by the appendages. Receptacle slender, curved or slightly sigmoid; the cells of the main axis, about twenty to twenty-five in number, more or less deeply suffused with blackish brown; the septa rather oblique; the apex distinct beyond the insertion of the stalk-cell of the perithecium. Appendages numerous, externally black and opaque, the inner margin more or less transparent, stiff, short, their tips more or less prominently and abruptly recurved, arising from all except the basal cell of the receptacle, and projecting obliquely upward; those at the base of the perithecium somewhat longer and more prominently curved away from its base on either side. Perithecium, 170–190 × 35–38 μ. Spores about 50 μ long (measured in the perithecium). Receptacle, 200–325 μ long. Appendages, 85–100 μ.

On an undetermined staphylinid allied to Lathrobium, Mt. Coffee, Liberia, Africa (O. F. Cook).

This species corresponds in all respects to the type so closely adhered to in all the other species of this genus, from which it may be readily distinguished by its long slender form and very numerous short recurved appendages. The types, which are in excellent condition, were found on the abdomen of the host, a small riparian staphylinid.

RHACHOMYCES FURCATUS Thaxter. Plate XII, figs. 1–3.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 467; *Acanthomyces furcatus* Thaxter l. c. Vol. XXVIII, p. 177.

Perithecium more or less suffused with brownish, straight, slightly inflated at the base, tapering gradually to the apex, borne on a stout and well marked stalk-cell. Receptacle more or less tinged with brownish, its main axis consisting of about twelve superposed cells, continued by a more slender prolongation beyond the base of the perithecium, this prolongation sometimes forming a second successive main axis terminated by a second perithecium and continued by a similar prolongation beyond the base of this second perithecium, which arises on the side of the general axis nearly opposite to that which bears the first. Appendages dark brown, opaque, stout, rigid, nearly straight or slightly curved outward, the longest not equalling the tip of the perithecium. Spores, 48 × 4 μ. Perithecia, 160–185 × 48–55 μ. Appendages (longest) about 150 μ. Total length to tip of receptacle about 360 μ. Main body of receptacle about 220 μ long. Total length when two perithecia present (longest), 550–600 μ.

On *Othius fulvipennis* Fab., Germany.

A number of specimens of this large and well-marked species were found on the abdomen of a specimen of its host in the collection of the Museum at Cambridge. It is characterized by

the conspicuous prolongation of its receptacle beyond the base of the perithecium, which gives it a more or less furcate habit. The perithecium is large and its stalk-cell more highly developed than that of any other species.

Rhachomyces Lathrobii Thaxter. Plate X, figs. 22–23.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 467; *Acanthomyces Lathrobii* Thaxter l. c. Vol. XXVIII, p. 178.

Perithecium becoming slightly suffused with brown, its blunt conical tip dark brown, contrasting; rather slender, slightly inflated towards the base, borne on a short stalk-cell more or less concealed. Receptacle consisting usually of eight to ten superposed cells, forming the main axis and deeply suffused with blackish brown except at the nearly hyaline septa. Appendages large, curved, almost opaque, nearly equalling, often greatly exceeding, the tip of the perithecium. Spores about 50 × 4 μ. Perithecia, 100–130 × 35–40 μ. Appendages (longer), 150–450 μ. Receptacle (average), 110 μ long.

On abdomen of *Lathrobium longiusculum* Grav., New Hampshire and Lake Superior; *Lathrobium* sp., Pennsylvania.

The appendages of the specimens from New Hampshire are constantly far longer than those of the Lake Superior specimens, resembling *A. pilosellus* in this respect. The two forms seem otherwise identical, and are distinguished from *A. pilosellus* by the characteristically brown-tipped perithecium, longer receptacle, and more densely crowded appendages. The infested hosts were all found in the collection of the Museum at Cambridge.

Rhachomyces pilosellus Thaxter. Plate XII, figs. 12–15.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 467; *Laboulbenia pilosella* Robin, Traité du Microscope, p. 912, fig. 285 (1871); *Acanthomyces brevipes* Thaxter, Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 177.

Perithecium suffused with reddish brown, subfusiform with a distinct stout stalk-cell. Receptacle very short, the main axis consisting usually of five superposed cells, with a short prolongation beyond the base of the perithecium, normally of not more than three or four cells, the cells all pale yellowish or with brown suffusions, the septa in all cases usually hyaline. Appendages few in number, opaque or nearly so, scattered, some of them very long, curved, and greatly exceeding the tip of the receptacle. Spores, 55 × 4 μ. Perithecium, 150–165 × 45–55 μ. Receptacle, main body about 75 × 30 μ, its prolongation about 35–40 μ. Stalk of perithecium about 40 × 30 μ. Appendages (longest), 375–500 μ.

On *Lathrobium fulvipenne* Grav., Germany.

This small species is distinguished from its near ally *R. Lathrobii*, by its shorter and differently shaped receptacle, concolorous perithecium, and scattered appendages. The specimens examined were obtained from material of its host in the collection of the Museum at Cambridge labelled "Germany," and were found growing on the insect's abdomen. I have been unable to discover any diagnosis of this species in Robin's "Traité" beyond the description of the plate, and was unaware that no description existed when I referred my own species to this form in the paper cited above. Although the name *R. brevipes* might very properly be retained, in view of

the lack of any proper description, it seems superfluous to complicate the synonymy further, and it must be confessed that Robin's figures, with their description, constitute quite as satisfactory a basis for determination as is afforded in the case of many other species.

CHÆTOMYCES Thaxter. Plate XI, figs. 20–22.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 178.

Receptacle consisting of a slender rigid series of superposed cells from which arise successively in a unilateral series the appendages, and one, rarely two, perithecia. Perithecium flattened stalked. Appendages one from each cell, simple or branched, produced one or more below the origin of the perithecium, the rest above it. Spores once-septate.

This well-marked type differs from other genera, from the fact that as many as three of the cells of the receptacle lying below the origin of the perithecia may give rise to appendages apparently fertile. The lowest of the latter which form the series above the perithecium, also seem to be fertile, producing a small number (one or two) of rather slender flask-shaped cells; but no discharge of antherozoids has been observed from them. The cells immediately above the origin of the perithecia bear no appendages, but the lowest sometimes produces a second perithecium. The perithecium appears to have four cells in each series of wall-cells, but it has not been possible to determine this beyond question.

Chætomyces Pinophili Thaxter. Plate XI, figs. 20–22.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 179.

Perithecium suffused with purplish, more deeply at the base and along its inner half, long, slender; the inner margin nearly straight, the outer curving inward distally to the prominent somewhat angularly inflated tip; the stalk-cells bent upward at the base, so that the axis of the perithecium is nearly parallel to that of the receptacle, the lower short and narrow, the upper becoming distally as broad as the perithecium, the basal cells of which are not distinguished from it and are similarly suffused with purplish. Receptacle bristle-like, composed of about fourteen superposed sub-cylindrical or somewhat flattened cells, almost or quite opaque and indistinguishable, the series usually bent backward at the base and, more abruptly, at the apex. Of these cells the three (rarely four) basal ones bear no appendages; above these one to three cells may bear fertile appendages, and are in turn succeeded by one, rarely two cells, from which are produced single perithecia; above these follow two to four cells without appendages, while the series is completed by five or six distal cells bearing short stout sparingly branched tapering hyaline, mostly sterile appendages. Fertile appendages hyaline, sparingly branched, the antheridia irregularly placed. Spores very slender and sharply pointed, $37 \times 1.5–2\ \mu$. Perithecia (including basal cells) $90–130 \times 22\ \mu$; stalk-cells about $30\ \mu$ long by $18.5–22\ \mu$ distally, $11\ \mu$ wide at base. Total length of receptacle $150–165 \times 7.5–8\ \mu$. Appendages (longer) about $50–60\ \mu$.

On *Pinophilus latipes* Er., Southern States.

A specimen of this host bearing the parasite in considerable numbers on the under side of its abdomen was found in the Leconte collection of Coleoptera. The fungus under a hand lens looks like a stiff slender bristle, and might readily be overlooked even when present in considerable numbers. The material, though abundant, contained no very young individuals, so that the early development is unknown.

SPHALEROMYCES Thaxter. Plates III and XI.

Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 95.

Receptacle consisting of two superposed cells, the upper bearing the appendage laterally, and the stalk-cell of the perithecium terminally. Perithecium asymmetrical, each series of wall-cells composed of five cells; the apex somewhat pointed, the stalk-cell free. Appendage consisting of a basal cell bearing a series of superposed cells, each of which gives rise from its inner upper angle to a single short septate simple antheridial branch. Spores once-septate. Ascogenic cell solitary.

This somewhat insignificant genus is perhaps related to Compsomyces, as may be indicated by the structure of its perithecium, the wall-cells of which are unusually numerous. The peculiar disposition of the canal cells near the tip has been already referred to (p. 231). The trichogyne has been observed in a single specimen only, which was badly broken. It appears to be filamentous and branched. Owing to its rarity the early stages have not been observed. In a single young specimen of *S. Lathrobii* (Plate XI, fig. 19) a perfect appendage was obtained, showing the sub-terminal origin of the flask-shaped antheridia, and the presence of a peculiar spine at the base of the sub-terminal cell, to which reference has been made above (p. 209). Although marked by no great peculiarities, the generic type is clearly defined by the two very distinct species.

SPHALEROMYCES LATHROBII, Thaxter. Plate XI, figs. 2–5, 19; Plate III, figs. 1–2.

Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 95.

Wholly hyaline or faintly yellowish. Perithecium rather slender, slightly inflated toward the base, tapering to the somewhat pointed apex which is bent inward; the dividing lines between the wall-cells indicated by successive ridges, the distal more prominent; the stalk-cell short, the basal cells rather large. Receptacle consisting of two obliquely superposed cells, the upper bearing the stalk-cell of the perithecium distally and the basal cell of the appendage laterally. Appendage borne on a large basal cell connected on its inner side with the distal cell of the receptacle and a portion of the stalk-cell of the perithecium, its exterior wall usually much thickened so as to form a more or less distinct rounded prominence at the base of the appendage proper, which consists of a series of four or five obliquely superposed cells diminishing in size towards its apex, from each of which arises on the inner side a single branch; the branches directed obliquely upward and forming a single series, septate, cylindrical, simple or bearing near their tips single short flask-shaped antheridia. Spores, $35 \times 3–3.5\ \mu$. Perithecia, $100 \times 22\ \mu$–$140 \times 36\ \mu$. Total length to tip of perithecium, 160–240 μ. Total length to tip of distal branch of appendage, 110–166 μ. Receptacle, 38–45 μ long.

On *Lathrobium nitidulum* Lec. and *L. punctulatum* Lec., Kittery Point, Maine; on *Lathrobium* spp. indet. Arlington, Mass., Lake Superior.

This species seems to be a rare one, and inhabits the legs and abdomen of its host, where, owing to its small size and pale color, it is detected with difficulty. Specimens on *L. nitidulum* are distinctly smaller than those on the second host, but otherwise there seems to be little variation in the rather insufficient material examined.

SPHALEROMYCES OCCIDENTALIS, Thaxter. Plate XI, fig. 1.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 469.

More or less evenly tinged with brownish. Perithecium large, subfusiform, with faintly defined ridges at the divisions between the wall-cells, the apex made externally oblique through the outgrowth of one of the lip-cells, which forms a pointed projection beyond the pore; the stalk-cell wholly free, tapering to a narrow base, and about as long as the receptacle proper. Receptacle small, pointed below, its sub-basal cell united throughout its length to the basal cell of the appendage, its basal and sub-basal cells separated by a horizontal septum. The appendage straight, rigid, tapering, composed of a series of usually four superposed cells separated by oblique partitions, and bearing short branches with flask-shaped antheridia from their upper inner angles. Perithecia, $200 \times 45\ \mu$. Length to tip of perithecia, $350\ \mu$. Length to tip of appendage, $200\ \mu$. Length of receptacle, $55\ \mu$.

On *Pinophilus densus* Lec., Utah.

The present form was found on the abdomen of its host, and is readily distinguished from *S. Lathrobii* by the peculiarly modified tip of its perithecium, as well as by other important differences. The scanty material examined was obtained from specimens of the host (a staphylinid beetle living under bark(?)) contained in the Le Conte collection.

COMPSOMYCES Thaxter. Plate XI.

Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 96; *Cantharomyces* Thaxter pro parte, l. c. Vol. XXIV, p. 9.

Receptacle consisting of two superposed cells, the distal bearing from its extremity several appendages and one, rarely two, stalked perithecia. Appendages sterile or fertile, simple or branched, septate; the fertile ones bearing one or more single one-celled antheridia, sessile at the extremities of the successive cells, which form the main axis of the appendage. Perithecium symmetrical, conical, borne on two superposed stalk-cells, the lower of which bears one, rarely two, terminal simple appendages. Asci eight-spored. Spores once-septate. Trichogyne copiously branched, the receptive tips coiled in a close spiral.

This genus, though closely related to and possibly identical with Moschomyces, has no other near allies, unless it be Sphaleromyces, and its position in the series is very doubtful. With the two exceptions mentioned, it differs from other genera with endogenous antherozoids in having five cells in each series of perithecial wall-cells. Moschomyces also is the only other instance in which the peculiar appendiculate basal stalk-cell characteristic of this genus is found. The trichogyne when well developed, as in fig. 9, is the most remarkable structure of its kind in

the whole family, its spiral terminations being invariably present and of very regular form. It is possible that the lower stalk-cell of the perithecium is morphologically a part of the receptacle and not homologous with the ordinary stalk-cells. Its early derivation, however, has not been determined.

Compsomyces verticillatus Thaxter. Plate XI, figs. 6–15.

Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 97; *Cantharomyces verticillatus* Thaxter l. c. Vol. XXIV, p. 9.

Nearly hyaline, becoming pale straw-yellow. Perithecium, very rarely more than one, not distinguished from its basal cells, inflated below, its slender, terminal portion tapering gradually to the blunt symmetrical apex, the eight basal and sub-basal wall-cells producing a corresponding number of more or less conspicuous prominences. Receptacle two-celled, the basal cell sometimes furnished with a partly blackened outgrowth from its base. Appendages two or three to eight or more, arising sub-verticillately from the sub-basal cell, simple or sparingly branched, the cells short and usually distally expanded. Spores, 20–22 × 3 μ. Perithecia, 90–150 × 20–35 μ; its two stalk-cells (longest), 185 μ. Receptacle, 18–80 μ. Total length to tip of perithecium, 140–400 μ.

On *Sunius longiusculus* Mann., Anna, Illinois and Kittery Point, Maine.

This graceful form was first received from Prof. S. A. Forbes, who kindly sent me two mounted specimens from Illinois, on which the original description was based. These specimens, however, were so imperfect that its really essential characters (the form and position of the antheridia) were not made out. Its general structure, however, seemed so like that of *Cantharomyces Bledii*, received at the same time from the same source, that the two were united under a common generic name. Later, more abundant material of *C. Bledii* and the discovery of two additional species offered an opportunity for a more exact characterization of the genus Cantharomyces on a basis of these three species, the *C. verticillatus* of my first paper being still in doubt until an abundance of material was obtained at Kittery.

The species varies very considerably in size according to its position on the host, specimens on the elytra and near the tips of the legs being often very small. The length of the receptacle also varies very considerably, and the hoof-like modification of the foot (fig. 13), which finds a parallel only in *Laboulbenia Philonthi* (Plate XXII, fig. 28) sometimes occurs. The rounded projections from the lower cells of the perithecial wall (fig. 11), are also very variable in form and are often hardly apparent. In very rare cases the lower stalk-cell of the perithecium may bear two appendages from its distal end, which though almost invariably simple, may sometimes produce short branches. Two perithecia (fig. 8) have been observed in only two instances. The antheridia (fig. 14) are produced in small numbers, one or two from the distal ends of some of the lower cells of the appendages.

The hosts are common in dry rubbish in cultivated fields.

MOSCHOMYCES Thaxter. Plate XI, figs. 16–18 and 26.

Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 97.

Receptacle composed of a sucker-like compacted mass of parenchymatous cells penetrating the softer chitin of the host and giving rise above to numerous free cells from the distal ends of which are produced solitary stalked perithecia and appendages. Perithecium very large, sub-conical, pointed, the apex symmetrical, borne on two simple superposed stalk-cells followed by three small basal cells ; the basal stalk-cell bearing from its distal end a single simple sterile appendage. Appendages septate, sparingly branched or simple, the fertile ones stouter, bearing the antheridia on short branchlets. Asci sub-cylindrical, eight-spored, arising in great numbers and in many rows from a single ascogenic cell. Spores minute, once-septate.

This genus, although at first sight so remarkably distinguished from all others by its habit of penetrating its host and by a cellular base, may yet prove merely a well-marked species of the preceding genus. This suggestion is made on the supposition that an "individual" such as is represented by fig. 16 is in reality an aggregation of as many individuals as there are cells in its penetrating base. The spores are discharged in enormous numbers from the perithecium, and show a marked tendency to adhere in masses (fig. 18). It is a question, therefore, whether the "individual" as figured does not represent the product of one of these masses and not the product of a single spore. Apart from this apparently compound habit, the essential characters of the genus are very similar to those of Compsomyces. If this supposition is correct, the sucker-like base is morphologically a compound foot, while the "numerous free cells" above described as rising from it represent the sub-basal cells of the true receptacle. Whether the latter has a basal cell distinct from the intruded cells cannot be seen in the specimens examined.

The antheridia are flask-shaped cells borne at the tips of short branches, which arise near the ends of the stouter appendages (fig. 26), and are unlike those of Compsomyces. In one specimen, unfortunately destroyed, several trichogynes were observed, which though not as luxuriant as is often the case in Compsomyces, were terminated by the same regularly coiled spiral branchlets. As far as can be determined, the asci arise from a single ascogenic centre, apparently a single large cell, but possibly a coherent group of cells. The asci (fig. 17) are sub-cylindrical, with a long, slender pedicel (partly broken in the figure), eight-spored and produced in very great numbers. The ascus mass is a most remarkable object when viewed in fresh material under the microscope. What may be called the dorsal view of this mass (represented in the second perithecium from the right in fig. 16) shows with great distinctness the round ends of a multitude of asci with their contained spores, projecting towards the observer and gradually losing themselves above in the mass of spores, which must be counted in a single perithecium almost by thousands. The structure of the perithecium is, like that of Compsomyces, unusual, there being five transverse series of wall-cells, the lower four marked by singular ridges.

Moschomyces insignis Thaxter. Plate XI, figs. 16–19.

Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 97.

Perithecium pale straw-colored, becoming tinged with brown, the lower portion slightly inflated and abruptly contracted at the base, the distal portion sub-conical, sometimes slightly bent to one side, the apex narrow, truncate, symmetrical, the surface marked by two series of ridges extending around the perithecium, each series composed of four distinct and prominent ridges placed somewhat irregularly and indicating the lines of separation between the middle and the upper and lower series of cells which form the walls of the main body of the perithecium; basal cells of the perithecium small, four in number, not distinguished from it, but somewhat abruptly distinguished from the distal stalk-cell, which is long, sub-cylindrical, sometimes inflated and curved; the basal stalk-cell usually shorter and smaller, bearing distally a single slender, simple, rather closely septate, tapering appendage, usually about as long as the distal stalk-cell. The appendages, which together with the single stalked perithecium spring in groups of three or four from the distal ends of large cylindrical cells projecting from the sucker-like receptacle (more rarely arising from the latter directly), are simple or once branched, either sterile or producing the solitary antheridia on short branches near their extremities. Spores very minute, acicular, septate near the middle, $12 \times 3\,\mu$. Asci sub-cylindrical, $40–45 \times 7.5\,\mu$, eight-spored, the spores sub-distichous. Perithecia, $225–290 \times 55–75\,\mu$, the stalk-cells (longest), $425\,\mu$, average, $375–25\,\mu$. Appendages, $175–375\,\mu$ long. Breadth of sucker-like receptacle, $75\,\mu$.

On *Sunius prolixus* Er., Waverly, Mass.

This form, which is among the most remarkable in the whole group, inhabits only the softer chitinous membranes of its host, beneath the elytra and at the bases of the legs or between the segments, which it perforates by the intrusion of its sucker-like base. From its large size it is readily seen, and when growing from the base of its host's legs projects upward, sometimes on both sides of the thorax, so that the whole or part of the perithecium rises free into the air. It appears to be decidedly rare, yet it will doubtless be found sufficiently abundant in localities where its host is more common than it has been found to be by the writer. It varies considerably as to the number of perithecia which it produces as well as the size and number of cells in its intruded base.

ZODIOMYCES Thaxter. Plate XXIII.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 263.

Receptacle attached by a single basal cell, above which it is parenchymatously multicellular, expanding distally; its extremity cup-shaped with a distinct rim, from the inner surface of which arise numerous sterile appendages, surrounding numerous stalked appendiculate perithecia and antheridial branches originating from the central parenchyma. Antherozoids exogenous, rod-like, terminal or short fertile appendages. Spores once-septate near their base.

The present genus is without doubt the most remarkable of the many remarkable members of the family, and presents a degree of vegetative development scarcely to have been looked for

in the group, while the origin of its perithecia is quite unique. Starting with the slender spore, the basal segment of which is far shorter than the terminal, the young plant begins its development by the formation of numerous transverse partitions in both segments (fig. 1). The distal cells give off a variable number of simple branches, and in the mean time longitudinal divisions appear here and there (fig. 2), which become rapidly more numerous (fig. 3) until the main body is for the most part divided into small, very numerous, squarish cells (fig. 4). The main body of the fungus then assumes a more or less clavate form, and is terminated by what may be called the *primary appendage*, the basal cells of which may have a few longitudinal septa (fig. 5), the distal ones producing long, slender branches. A more rapid growth peripherally of the portion below the base of this primary appendage causes the wall-cells in this region to arch outward, producing a more or less distinct cavity, completely enclosed within, as is indicated in fig. 5. As this cavity enlarges, secondary appendages begin to grow inward and upward from the inner surfaces of the cells forming its lateral walls; while from the cells forming its floor the perithecia arise. As a result the secondary appendages break through at the base of the primary appendage, which is turned to one side and soon disappears. This condition is shown in fig. 6, in which the terminal cavity is indicated partly as if seen in section, the secondary appendages having burst out above it and turned the primary appendage to one side, its base being represented at the left. The cavity goes on enlarging till the perithecia begin to be protruded within the circle of secondary appendages (fig. 7); while by further general growth the mature condition is finally reached, as represented in fig. 8. A longitudinal section through the fertile portion of an adult individual then presents the condition shown in fig. 9, which is drawn from a microtome section kindly made for me by Dr. Richards, but is to some extent diagrammatic. Half only of the cup-like extremity is represented, the rim at the right showing the sterile secondary appendages arising from its inner face. The flattened bottom of the cup is seen to consist of crowded parenchyma cells, from which arise directly the perithecia in various stages of development, and the small and inconspicuous antheridial appendages. The latter consist of a few, usually three, superposed, rather short cells, bearing at the tips (figs. 21–23) one to three (usually two) rather large, rod-like bodies, which must be considered exogenous antherozoids, and suggest in a way the spermatia of some lichens. These appear to be formed successively, as in the case of Ceratomyces; but owing to the comparatively small size of the antheridia and the difficulty of observing them in crushed specimens, this point could not be definitely ascertained. The antherozoids themselves evidently fall off; since they may frequently be found lying loose about the bases of the perithecial stalks, and in this position they seem to be sought out by the trichogynes, which at first invariably grow downward (figs. 9 and 16).

The development of the perithecium is illustrated by figs. 10 to 20 and fig. 25. They arise primarily as an outgrowth or upgrowth from one of the superficial cells forming the bottom of the cup. This protrusion elongates and becomes divided by two septa into three superposed cells (fig. 13). Of these cells the upper, as far as can be determined, follows a development similar to that by which the perithecium is usually formed in members of the group dividing into two primordial cells (fig. 14), the lower of which forms the perithecium proper, the latter the procarpe. The trichogyne is always simple and terminal, consisting of a filament of variable length, which, as has just been mentioned, grows downward (fig. 16) towards the base of the

stalk. The great variability in the length of the trichogyne is a further indication that it seeks the antherozoids, continuing to elongate until one of the latter becomes fixed to it, after which it is drawn up into a more or less horizontal position through a curvature at its base (fig. 17). In all of the many observed cases, the antherozoid has been found attached to the tip of the trichogyne, a further confirmation of the view just expressed (figs. 17, 18). After the adherence of the antherozoid the trichogyne soon shrivels, remaining for a time as a slight terminal prominence (fig. 25). Meantime one of the cells at the base of the perithecium, perhaps corresponding to the secondary stalk-cell of other instances, produces a curious short, blunt, upturned outgrowth (fig. 19) without visible significance. The four cell-rows of the perithecial wall then become more or less apparent; but the exact number of cells in each is determined with considerable difficulty. Six cells may, however, in favorable specimens be made out, and in the single type species the third cell from the tip of each row produces an appendage. These appendages (figs. 10–12, etc.) are so placed that those arising from the dorsal cell-rows are higher than the others, and arise side by side; while those from the lateral cell-rows spring from opposite sides of the perithecium. They begin to develop by budding outward after the perithecium is nearly mature (fig. 20) and have no special significance, their purpose being probably protective. The terminal cells of the perithecium end each in a short, sharp, slender projection (figs. 9–11). The ascogenic cell appears to be solitary, but this point has not been made out definitely. At maturity the septa of the basal cells of the perithecia are apparently obliterated, as are the cavities of the wall-cells. The main body or receptacle of the mature individual is attached by a single large, slightly colored cell, above which it may produce more or less solid cellular outgrowths, simple, lobed, or even branched, and arising from one or both sides. These outgrowths, which are doubtless designed to prevent sudden lateral bending, are very often wholly wanting even in old individuals. The medullary portion of the receptacle, which lies below the perithecigerous area, is made up of cells charged with dense yellowish fatty protoplasm.

Zodiomyces vorticellarius Thaxter. Plate XXIII, figs. 1–24.

Proc. Am. Acad. Arts and Sci. Vol. XXIV, p. 263; Saccardo Sylloge, Vol. IX, p. 1130.

Hyaline or livid with a central yellowish tinge, often suffused basally with dull purplish above and including the sometimes nearly opaque basal cell. Perithecia numerous, variable in number, each terminal on a slender cylindrical stalk of two superposed cells, becoming sub-lateral through the production of a short lateral upturned blunt outgrowth, arising from a short cell cut off below its base; its apex more or less pointed, curved strongly forward from the base of a pair of blunt rather stout sub-cylindrical or sub-clavate recurved appendages, which arise side by side from its posterior surface; producing laterally on each side, lower than the first, a second appendage, long, slender, curved outward and backward, tapering to a more or less attenuated tip: the body of the perithecium slightly inflated, stouter distally, narrowed towards its base, its basal cells (three?) small and ill defined. Receptacle very variable in size and form, expanding distally to the cup-like extremity from within the margin of which arise numerous crowded, cylindrical, septate, simple or sparingly branched sterile appendages which surround and greatly exceed in length the mass of perithecia: below more or less attenuated, often producing near

the base cellular outgrowths on one or both sides, which vary in form and size. Spores, $45 \times 2.5–3\ \mu$. Perithecia, $55 \times 15\ \mu$, dorsal appendages, $15–30 \times 5\ \mu$, lateral appendages longer, $50 \times 3\ \mu$, pedicel, $35–50 \times 3.5–4\ \mu$. Sterile appendages longer, $200–220 \times 3–4\ \mu$. General receptacle, $220–900\ \mu$; width at distal end $90–180\ \mu$; the basal outgrowths, longest, $365\ \mu$.

On *Hydrocombus lacustris* Lec. and *H. fimbriatus* Melsh. Near New Haven, Connecticut; York, Maine. On an undetermined Hydrocombus (?) from Slaughter, Washington (Miss Parker).

This species presents very great variations in size and form, being elongate with a slender base or short and stout; and, though usually nearly symmetrical at maturity, is sometimes very considerably bent or distorted; such differences depending doubtless largely upon the position in which it grows. The basal cushion-like outgrowths, when present, are also very variable in form and size, and are not infrequently once branched. In most instances their cells are arranged with a certain degree of definiteness (fig. 8), but are not infrequently irregularly massed. In its younger conditions, for some time after the perithecia and appendages have broken out, the plant may have a one-sided appearance until the original terminal portion (primary appendage) has sloughed off; after which the cup-shaped extremity becomes usually quite symmetrical. The antheridia are recognized with considerable difficulty, owing to their small size, and do not appear to be very numerous; but young perithecia with trichogynes are always sufficiently abundant.

The species was first found on hosts collected in a brook fed by a pond in West Haven, Conn.; but not in any abundance. More recently sufficient material has been obtained from the brook immediately below Chase's Pond at York, Me., while several specimens were found on an undetermined host, kindly collected for me in Washington by Miss Parker. It is therefore doubtless widely distributed in this country, though perhaps never very common. The hosts are most readily obtained in gravel just at the margins of cool brooks, or in leaves and other rubbish caught on partly submerged rocks or sticks in similar situations, and the parasite, owing to its large size and pale color, is very readily seen, attached to the legs and in various positions on the lower surface of the thorax and abdomen.

CERATOMYCES[1] Thaxter. Plates XXIV–XXV.

Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 34.

Receptacle consisting of a variable number of superposed cells bearing terminally the perithecium and appendage. Perithecium consisting of four rows of wall-cells, each containing numerous cells, always more than six, often several times this number (seven to sixty-five), the apex various, often with a sub-terminal appendage. Appendage stout, tapering to a branched extremity; consisting of a single series of superposed cells, from the upper inner angle of which may arise branches more or less copious and well developed. Asci clavate, four-spored. Spores acicular, once-septate. Antherozoids long, rod-shaped, exogenous.

The accumulation of numerous species in this genus has rendered its precise description a matter of some difficulty; since, although its characters are well marked, the different species

[1] This name occurs in Streinz, Nomenclator Fungorum, where reference is made to "Ceratomyces candidus Sturm." An examination of the citation, however, shows this name to be a misprint for *Crateromyces candidus*.

are remarkably variable. The horn-like appendage, which characterizes the perithecia of the species first described, does not prove of generic value, since it is absent in four forms. The only genus which might possibly be mistaken for it, however, is Sphaleromyces; but the presence in this case of flask-shaped antheridia on the branches of the appendage, not to mention its well-developed perithecial stalk-cell, distinguish it without difficulty. Its greatest peculiarity lies in the character and development of the perithecium, which differs from the more typical forms in important points; and although I have been unable to obtain young material which illustrates all the early stages, it appears in *C. mirabilis* to be as follows: The young individual consists of a simple series of superposed cells, the distal of which begin to branch at an early stage; and the first indication of the formation of the perithecium consists in the division by a transverse septum of one of the cells of this series. Of the two cells resulting from this division, the upper grows outward and upward, its outgrowth becoming a finger-like projection (Plate XXIV, fig. 4, at the left) that later elongates to form the filamentous trichogyne. This outgrowth, in the stage represented by the figure, has become divided by two transverse partitions into three cells; the upper being the young trichogyne, the cell below it the trichophoric cell; while below this, not projecting from the axis of the plant, is the smaller carpogenic cell. At the right of the carpogenic cell a vertical septum has divided the remainder of the original upper cell into two parts, an outer and an axile cell; but in other species, like *C. contortus* (Plate XXV, fig. 9), this division seems to be absent. The lower of the two original cells has, in the mean time, been divided by a vertical septum into two cells, one of which (Plate XXIV, fig. 4, *x*) has also begun to grow outward and upward. As far as can be determined, this cell (*x*) by further growth and division produces only one of the series of wall- and canal-cells; while the cell previously referred to as the axile cell, lying behind the carpogenic cell, gives rise to the three other series. Having been unable to separate the cells in this region and ascertain their protoplasmic connections with the cells of the perithecium, it is uncertain whether the above statement is entirely correct in so far as concerns the number of wall-cells originating from each of the cells mentioned; but that they give rise to the outer and inner series of perithecial cells cannot be doubted. The latter grow up around and beyond the carpogenic and trichophoric cells, and by the successive division of their terminal members form the main bulk of the perithecium. The base of the trichogyne is thus left behind, as it were, in the angle between the perithecium and the appendage (Plate XXIV, fig. 5, and Plate XXV, fig. 17), where it often persists for some time. While in other genera, as a rule, only one or two divisions of the perithecial cells takes place above the insertion of the trichogyne, in the present instance the growth beyond it may be almost indefinite; as in *C. rostratus*, for example, or *C. filiformis*, in each of which (Plate XXIV, fig. 15 and 18) the perithecium is extraordinarily developed. Although the general process by which the perithecium originates is thus very similar to that which has been described as characteristic of Stigmatomyces or Laboulbenia, it will be observed that its basal cells are differently arranged, and originate in a different manner. Whether it is possible to homologize the typical stalk-cell and secondary stalk-cell with any of those present in this case I do not feel able to determine. The perithecial cells of the inner series differ from those of other genera from the fact that they seem to divide quite independently of, and less frequently than, the wall-cells; as may be seen in fig. 8, Plate XXIV, the septa of the wall-cells (*w c*) and of the canal-cell (*c c*) in this instance being by no means coincident. As in other cases, the canal-cells are entirely destroyed by the

pressure of the spore mass, and there are indications that they are absorbed even before this pressure is exerted.

The procarpe, as we have seen, is identical with that of other genera, and the further development of the carpogenic cell, although it has not been traced out in detail, seems to correspond in all respects to that which has been previously described. In species in which it has been possible to determine the number of ascogenic cells with definiteness, four have been seen in every case; but a certain irregularity in the position of the asci in relation to them is often observable, the ordinary biseriate arrangement being at least obscured.

The young individuals of species of this genus bear a close resemblance to those of Zodiomyces, and the slender acicular spores, as in the last named genus, are septate nearer to the base than to the apex except in *C. terrestris.* A further peculiarity of the spores is observable in *C. furcatus* and *C. contortus*, in both of which the septum that divides the spore involves its gelatinous envelope also, which is prominently constricted in this region (Plate XXV, figs. 4 and 10).

The trichogyne is always filamentous, usually not very long, and simple or sparingly branched. The antherozoids are clearly differentiated only in *C. rostratus* (Plate XXIV, figs. 21 and 24) and *C. terrestris* (Plate XXV, fig. 23), in both of which they are long, rod-shaped bodies that fall from their attachment soon after they are formed. In other species they appear to result from the segmentation of slender branches into rod-like pieces like those of the two forms mentioned. It is difficult to obtain trichogynes in a receptive condition, and in only a single instance have I found one to which three or four of the long antherozoids were firmly attached.

The species are in a way divisible into sub-groups corresponding to the genera of the hosts which they inhabit. The three species on Berosus as well as the four on Tropisternus have a distinct family resemblance in either case; while *C. rostratus* is almost sufficiently distinct to be placed in a genus by itself; its chief peculiarity being connected with the production of adventitious branches from about the base of the appendage and perithecium, and the definite and successive production of its antherozoids. It may be mentioned that it is approached in both these respects by the singular little terrestrial form *C. terrestris.* What the near affinities of this peculiar and comparatively imperfectly known genus are, it is difficult to say, although its exogenous antherozoids and the form of its young conditions indicate a nearer relationship with Zodiomyces than with any other known forms.

The species all inhabit aquatic beetles of a single family (Hydrophilidæ), with the exception of *C. terrestris*, which is found on a staphylinid that lives in very wet situations.

Ceratomyces mirabilis Thaxter. Plate XXIV, figs. 1–10.

Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 34; l. c. Vol. XXX, p. 480.

At first pale, becoming more or less deeply suffused with amber-brown. Perithecium straight externally, more or less inflated internally, the cell-rows composed of from twenty to thirty cells, the anterior row ending below the apex in an appendage often equalling the perithecium in length and tapering to a blunt point, or when broken sometimes producing a few slender terminal branches, becoming blackened and inflated near its base, composed of from ten to sixteen

superposed cells. The posterior row terminates opposite the base of this appendage in a bilobed prominence beyond which the short more or less pointed apex is often strongly bent to or towards the base of the perithecial appendage. Antheridial appendage short and stout, usually less than one third as long as the perithecium, sub-conical, with numerous branches produced from its inner side, slender, rather rigid, with more or less divergent branchlets. Receptacle consisting of three superposed cells, followed by two cells; the posterior larger and followed by the basal cells of the appendage; the anterior much smaller, followed by a second cell about equalling it in size, beyond which follows the base of the perithecium: the basal cell wholly or partly hyaline or translucent above the large jet black foot; the remaining cells deeply blackened except along their anterior edges, the blackening involving the base of the antheridial appendage. Spores, 110–120 × 4 μ. Perithecia, 280–300 × 65–70 μ, longest, 330 μ, its appendage, 180–200 μ. Total length to tip of perithecium, 400–525 μ. Antheridial appendage (exclusive of its branches) about one third as long as the perithecium.

On *Tropisternus glaber* Hb. and *T. nimbatus* Say, Milford, Connecticut; Arlington, Mass.; Kittery Point, Maine.

This species, though perhaps the commonest member of the genus, seems never very abundant. It is subject to a good deal of variation in size, but is otherwise very constant in its characters and easily distinguished from the rarer *C. confusus*. It is found on the lower surface of the abdomen and thorax of its host, especially along the margin of the former on the left side, and is conspicuous from its large size.

It may be mentioned that this species, and probably the succeeding, is subject to the external parisitism of a Chytridiaceous parasite of singular structure resembling the Obelidium of Nowakowski in some respects, but apparently belonging to an undescribed genus. The development of this plant has not, however, been as yet fully made out.

Ceratomyces confusus Thaxter. Plate XXIV, figs. 11, 12.

Proc. Am. Acad. Arts and Sci. Vol. XXX, p. 480.

General habit and color as in *C. mirabilis*. Perithecium hardly inflated, its inner margin curving evenly to the prominent blunt apex which stands out free from the base of the perithecial appendage. The perithecial appendage shorter and usually stouter than in *C. mirabilis*, without the bulbous inflation at its base. Axis of antheridial appendage long and slender, distally attenuated, with comparatively few short branches. Receptacle as in *C. mirabilis*. Spores, 75–90 × 3.7 μ. Perithecia, 235–335 × 65 μ. Axis of antheridial appendage 235 μ (longest). Receptacle, 165 × 75 μ.

On *Tropisternus glaber* Hb. and *T. nimbatus* Say, Milford, Connecticut, and Kittery Point, Maine.

This species is much rarer than *C. mirabilis*, and is at once distinguished by the absence of any posterior prominences below the apex of the perithecium, as well as by the differences presented by its perithecial and antheridial appendages. Its spores also seem constantly smaller, and although the two species are so strikingly similar, it is unlikely that they are mere varieties of a single form. It occurs, like the preceding species, along the inferior margin of its host's body, but almost always on the opposite (right) side.

CERATOMYCES CAMPTOSPORUS Thaxter. Plate XXIV, figs. 13, 14.

Proc. Am. Acad. Arts and Sci. Vol. XXVII, p. 35.

Pale amber-brown. Perithecium strongly curved near the base, rather stout, its cell-rows made up of from thirty-five to forty members which, on the anterior row, are somewhat inflated and constricted at the septa, giving a strongly corrugated outline on this side, the inner margin bent abruptly almost at right angles to the blunt tip, below which, externally, a nearly straight erect perithecial appendage arises, composed of six or more superposed cells, sometimes bearing terminal branchlets. Antheridial appendage consisting of a short curved basal cell, above which it is abruptly expanded, tapering thence to a rather slender tip; the antheridial branchlets terminal, few in number (or wholly broken off). Receptacle very small, consisting of a few superposed cells for the most part black and opaque. Spores slightly swollen, and bent near the apex, long and slender, 110 × 3.5 μ. Perithecia, 275 × 85–90 μ. Receptacle, 90 × 50 μ.

On *Tropisternus glaber* Hb., Milford, Connecticut; Arlington, Mass. On *T. striolatus* Lec., Texas.

This species appears to be very rare, and I have collected it but once since the three types were found at Milford. A specimen on the above-mentioned host from Texas seems to correspond in all essentials, though not in very good condition, and is more rigid in form without the sub-sigmoid habit of the other specimens. The type-form is at once distinguished by the character of its antheridial appendage, the form of its perithecium, and especially by its greatly reduced and almost wholly blackened receptacle and the characteristic irregularity of its spores. It is found along the lower margin of its host, but was attached to the edge of the elytron in the only specimen in which its exact position was noted.

CERATOMYCES FILIFORMIS Thaxter. Plate XXIV, figs. 15–17.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 187.

Suffused with dark amber-brown. Receptacle consisting of three superposed cells, the basal one partly blackened, surmounted by two cells which form the origin of the perithecium and antheridial appendage. Perithecium very long and slender, hardly inflated, tapering abruptly and symmetrically to the subtruncate apex, the cell-rows composed of very numerous cells (maximum forty-five). Appendage short, tapering, straight, bearing terminally or sub-terminally one or two slender branches. Spores, 55–60 × 3 μ. Perithecia, 250–330 × 33–40 μ. Receptacle, 35 × 85 μ. Appendage, 90 μ.

On the edge of the elytra of *Tropisternus glaber* (Hb.) and *T. nimbatus* Say, Milford, Connecticut; Arlington, Mass., and Kittery Point, Maine.

This species was at first taken for an abnormal form, but sufficient material shows that it is a well-marked species. It occurs near the tip of the elytron on the upper surface, and is with difficulty distinguished from the bristle-like hairs among which it occurs. It is remarkable for the very small number of spores present in the perithecium, which is more commonly almost empty, especially in specimens in which there are the greatest number of wall-cells. It is never found in abundance and seems decidedly rare.

Ceratomyces miniscolus Thaxter. Plate XXV, figs. 15–18.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 187.

Becoming more or less deeply tinged with amber-brown. Receptacle consisting of about three superposed basal cells, all blackened, opaque, and indistinguishable, surmounted by a few small cells partly blackened below, from which arise the appendage and perithecium. Perithecium sub-conical, ten or eleven cells in each cell-row, a short blunt conical unicellular projection borne sub-laterally below the tip, which is usually curved slightly outward. Appendage tapering to a slender tip, simple, or bearing a few short branches near its apex, seldom as long as the perithecium. Spores, $75 \times 4\ \mu$. Perithecia, $110–150 \times 30–40\ \mu$. Receptacle, average, $90 \times 40\ \mu$. Appendage, $50–110\ \mu$ long.

On *Tropisternus nimbatus* Say, Kittery Point, Maine; Milford, Connecticut; Texas.

This curious little species occurs rather rarely, growing appressed on the lower surface of the hyaline outer margin of the right elytron of its host, usually near the tip, and is readily distinguished by its relatively large jet-black receptacle, which is about as large as the perithecium itself. It is not readily obtained in good condition.

Ceratomyces terrestris Thaxter. Plate XXV, figs. 19–24.

Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 94.

Nearly hyaline, with black or dark brown suffusions. Perithecium large, slightly inflated, tapering to a bluntly rounded or truncate apex, from which the sharply pointed lips project; the wall of the perithecium consisting of four series of about twelve cells each, its base formed from three small cells, below which a single similar small cell connects it with the receptacle. Receptacle consisting of three small superposed squarish cells, the upper of which gives rise to the perithecium and the appendage. The appendage, consisting of six or more superposed, flattened cells becoming externally suffused with blackish brown or black (the suffusion sometimes involving the whole series as well as the entire receptacle, with the exception of its basal cell), bearing on its inner side numerous hyaline branches simple or once or twice branched, the lower arising from a series of small cells which may extend across the base of the perithecium on one side. Spores, $15 \times 2.5–3\ \mu$. Perithecium, $75–90 \times 22–29\ \mu$. Receptacle, $25\ \mu$ long. Total length to tip of perithecium, $100–140\ \mu$, to tip of main appendage, $45–65\ \mu$. Longest branches of appendage, $75\ \mu$.

On *Lathrobium punctulatum* Lec., Kittery Point, Maine; Arlington, Mass.

This minute and curious species is chiefly interesting from the fact that it is a terrestial form in a typically aquatic genus, of which, however, it seems to possess all the essential characters. In contrast to its congeners, it is among the smallest of all the Laboulbeniaceæ, and is very readily overlooked. It inhabits the legs of its host as a rule, but is sometimes found on the abdomen. It varies considerably in the number of branches which arise from the appendage or from cells near its base, and some of these branches are peculiar, for what appears to be a gelatinous modification of their tips, which result in the clavate form shown in figs. 20–21. In the majority of specimens the branches are wholly broken off, as in figs. 19 and 22. Unlike the other species of the genus, the spores appear to be septate near the apex.

CERATOMYCES ROSTRATUS Thaxter. Plate XXIV, figs. 18–27.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 188.

Reddish or amber-brown. Receptacle long, slender, expanding slightly upward, consisting of about twelve superposed cells. Perithecium consisting of a clearly distinguished neck and an inflated oval basal portion, completely filled with spores and asci, which pushes the appendage to one side and continues directly the axis of the receptacle; the neck very elongate, irregularly cylindrical, straight or its terminal portion at maturity (in perfectly developed specimens) abruptly bent upon itself, the recurved portion tapering slightly to the hunched asymmetrical apex; the cell-rows made up of seventy cells, more or less. Appendage arising from a broad base flattened at maturity by pressure from the base of the perithecium, consisting of about six superposed cells bearing numerous branches, which may in turn be several times branched. Spores about $75 \times 3.5\,\mu$. Perithecia, basal portion, $110–150 \times 65–90\,\mu$; neck, including recurved portion, longest, 1.17 mm. Appendage about $90–100\,\mu$ long, its longest branches about $200\,\mu$. Receptacle, large, about $260\,\mu$ long by $55\,\mu$ at the distal end.

On *Hydrocombus fimbriatus* Melsh., Massachusetts, Texas; *Philhydrus cinctus* Say, Maine. A variety on *P. nebulosus* Say, Maine.

The most remarkable species of the genus, the enormously elongated neck of the perithecium becoming hooked only in fully mature specimens, and serving an evident purpose in the spore dissemination during coitus.

In perhaps a majority of specimens the neck is shorter and straight, and there are very considerable variations in size and form. The appendage is often very broad at its base, and projects outward, often at a considerable angle; while its basal cells may be irregularly divided and produce branches which, in some cases, even seem to arise from the lower perithecial wall-cells, forming a rather dense tuft, while in other cases they are more sparingly developed. The number of cells composing the receptacle is subject to considerable variation; and the cell-rows of the perithecium present very great differences in the number of their component cells. Unlike any other species, there is a distinct differentiation between the terminal conductive portion of the perithecium and its inflated ascigerous base, which is, apparently through pressure of its contents, hardly distinguished in many cases from the base of the appendage. The antheridial branches and the antherozoids of this species, which are peculiar in many respects, have been already alluded to (p. 210). The typical form is probably widely distributed, and is not uncommon in the brook below the cascade at Waverly and in some other localities about Boston. A few specimens were also obtained from a Texan specimen of *Hydrocombus* in the Museum collection, and it occurs rarely on *Philhydrus cinctus* at Kittery Point, Maine. A small variety which should not, I think, be separated specifically from the present form, occurs on the lower surface of the elytra of *P. nebulosus* Say, near the tip or the outer margin, and is represented in figs. 26, 27. Although so very much smaller, and apparently always confined to the situation mentioned, it possesses no essential differences by which it can be distinguished from many forms of the present species, which is found on the inferior surface of the abdomen and thorax of its host and not unfrequently on the legs. It is subject to the attack of a chytridiaceous parasite similar to that which occurs on *C. mirabilis*, but specifically distinct.

CERATOMYCES FURCATUS Thaxter. Plate XXV, figs. 1–4.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 186.

Hyaline, becoming more or less suffused with reddish brown, the appendages sometimes purplish. Receptacle composed of three or four superposed cells, surmounted by two cells, from which arise the perithecium and appendage. Perithecium large and stout, externally nearly straight, inwardly inflated and strongly curved to the pointed apex, below which arises externally and sub-laterally a large, stout, flexed appendage, tapering and bearing toward its tip a single row of short branches, which may be in turn once branched. Cell-rows of perithecium each consisting of about eight cells. Antheridial appendage very large, consisting of twenty cells (more or less) bearing branches at irregular intervals from its inner surface. Spores, 85–90 × 4 μ. Perithecia, 130–150 × 45–60 μ. Receptacle, 90–110 × 45–55 μ. Antheridial appendage, 300–425 μ. Perithecial appendage about 325 μ.

On *Berosus striatus* Say, Maine.

This singular-looking species occurs, so far as I have observed, only on the right side of the lower surface of the thorax in small groups. Its very large antheridial appendages distinguish it from other species, and give it the Y or V form which has suggested the specific name. The spores, like those of *C. contortus*, are peculiar in that the septum involves also the gelatinous envelope. It seems to be a decidedly rare form, and with *C. humilis* and the last mentioned species, all occurring on the same host, has been thus far found only at Kittery Point, Maine, in a small pond near the highest point of Cutts Island.

CERATOMYCES CONTORTUS Thaxter. Plate XXV, figs. 5–10.

Proc. Am. Acad. Arts and Sci. Vol. XXVIII, p. 186.

Hyaline, becoming very faintly brownish. Receptacle consisting of three superposed cells, above which three cells form the general base of the perithecium and appendage. Perithecium long and slender, usually constricted at the base so as to appear short stalked, slightly inflated and bent outward, the apex pointed and curved. A short appendage arises sub-laterally below the apex and is strongly curved, extending inward beyond the apex, its fifth and sometimes also its sixth cell producing from its upper surface a stout branch which may be simple or may bear secondary branches at irregular intervals. Antheridial appendage consisting of about twelve superposed cells, producing a few branches from its inner side at irregular intervals, the branches in turn more or less irregularly branched. Spores, 80–85 × 3–3.5 μ. Perithecia, 200–260 × 35–45 μ. Receptacle about 125 μ long. Antheridial appendage, 110–130 μ. Perithecial appendage, 75 μ long.

On *Berosus striatus* Say, Kittery Point, Maine.

This species is somewhat more frequently met with than the preceding, and is usually found on the lower surface of the abdomen on the left side near its tip. It is readily distinguished from *C. furcatus* by its more slender habit, almost stalked perithecium, much smaller appendages and generally malformed and distorted habit. It has as yet been found only in the locality men-

tioned under the preceding species, to which it is most nearly allied. As already stated, its spores are peculiar for the constriction about their septum, which involves the gelatinous envelope.

Ceratomyces humilis Thaxter. Plate XXV, figs. 11–14.

Proc. Am. Acad. Arts and Sci. Vol. XXIX, p. 94.

Hyaline, becoming faintly tinged with brownish. Perithecium rather narrow, without any appendage, the apex blunt or nearly truncate, its cell-rows composed of not more than seven cells. Receptacle composed of from two to five superposed squarish cells. Appendage consisting of six to twelve superposed cells, the series tapering distally and producing irregularly from its inner face branches which may in turn be several times branched and may reach a length twice that of the perithecium. Spores, $22 \times 3\,\mu$. Perithecia, $100 \times 25\,\mu$. Total length to tip of perithecium, 150–185 μ. Longest branches of appendage, 180 μ.

On *Berosus striatus* Say, Kittery Point, Maine.

A somewhat insignificant species allied to *C. contortus*, from which it is easily distinguished by its small size and by the absence of any appendage near the tip of the perithecium. It occurs more frequently between the terminal claws of the middle pair of legs, but is rarely found on the elytra. In two specimens the perithecia have become distinctly tinged with brown, but as a rule the whole plant is hyaline.

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INDEX OF HOST INSECTS.

NAME OF HOST INSECT.	NAME OF PARASITE.
COLEOPTERA.	
CARABIDÆ.	
Acrogenys hirsuta Maclean,	Laboulbenia australiensis Thaxter.
Acupalpus carus Lec.,	Rhachomyces lasiophorus Thaxter.
Agonoderus pallipes Fabr.,	Laboulbenia polyphaga Thaxter.
Amara sp. indet.,	" " "
Anisodactylus baltimorensis Say,	" compressa Thaxter.
" " "	" elongata Thaxter.
" " "	" macrotheca Thaxter.
" **Harrisii** Lec.,	" filifera Thaxter.
" **interpunctatus** Kirby,	" " "
" **nigerrimus** Dej.,	" " "
" " "	" lepida Thaxter.
" " "	" Pterostichi Thaxter.
" spp. indet.,	" filifera Thaxter.
" " "	" macrotheca Thaxter.
Anomoglossus pusillus Say,	" variabilis Thaxter.
Anophthalmus Bilimeki Sturm.,	Rhachomyces hypogæus Thaxter.
" **Menetriesii** Motsch.,	Laboulbenia subterranea Thaxter.
" **Motschulskyi** Schm.,	" " "
" **pusio** Horn,	Rhachomyces speluncalis Thaxter.
" **tenuis** Horn,	Laboulbenia sp. indet.
Aptinus mutilatus Fabr.,	" europæa Thaxter.
Aspidoglossa subangulata Chaud.,	" Aspidoglossæ Thaxter.
Atranus pubescens Dej.,	Rhachomyces lasiophorus Thaxter.
" " "	Eucantharomyces Atrani Thaxter.
Badister maculatus Lec.,	Laboulbenia polyphaga Thaxter.
" **micans** Lec.,	Rhachomyces lasiophorus Thaxter.
Bembidium Andreæ F.,	Laboulbenia vulgaris Peyritsch.
" **bimaculatum** Kirby,	" curtipes Thaxter.
" **bipunctatum** Duft.,	" vulgaris Peyritsch.
" " "	" luxurians Peyritsch.
" **complanulum** Mann.,	" cornuta Thaxter.
" **decorum** Pz.,	" vulgaris Peyritsch.
" **fasciolatum** Duft.,	" " "
" **femoratum** Sturm.,	" " "
" **flammulatum** Clairv.,	" " "
" " "	" luxurians Peyritsch.
" **lævigatum** Say,	" vulgaris Peyritsch.
" **littorale** Pz.,	" " "
" **lunatum** Duft.,	" " "
" " "	" flagellata Peyritsch.

NAME OF HOST INSECT.	NAME OF PARASITE.
Bembidium mexicanum Dej.,	Laboulbenia vulgaris Peyritsch.
“ **obsoletum** Dej.,	“ “ “
“ **punctulatum** Drap.,	“ “ “
“ **varium** Oliv.,	“ luxurians Peyritsch.
Blethisa multipunctata Fabr.,	“ variabilis Thaxter.
“ **quadricollis** Bald.,	“ “ “
Brachinus crepitans L.,	“ Rougetii Mont. and Robin.
“ **explodens** Duft.,	“ “ “ “ “
“ “ “	“ europæa Thaxter.
“ **mexicanus** Dej.,	“ Brachini Thaxter.
“ **scolopeta** Fabr.,	“ Rougetii Mont. and Robin.
“ spp. indet.,	“ Brachini Thaxter.
“ “	“ texana Thaxter.
Bradycellus rupestris Say,	“ inflata Thaxter.
Callida pallidipennis Chaud.,	“ minima Thaxter.
Callistus lunatus Fabr.,	“ europæa Thaxter.
Casnonia pennsylvanica Linn.,	“ Casnoniæ Thaxter.
Catascopus guatemalensis Bates,	“ Catascopi Thaxter.
“ spp. indet.,	“ “ “
Chlænius æneocephalus Dej.,	“ europæa Thaxter.
“ **æstivus** Say,	“ variabilis Thaxter.
“ **chrysocephalus** Rossi,	“ europæa Thaxter.
“ **cumatilis** Lec.,	“ variabilis Thaxter.
“ **cursor** Chev.,	“ “ “
“ **floridanus** Horn,	“ “ “
“ **leucoscelis** Chaud.,	“ “ “
“ **pennsylvanicus** Say,	“ “ “
“ **ruficauda** Chaud.,	“ “ “
“ **sparsus** Lec.,	“ “ “
“ **tenuicollis** Fabr.,	“ proliferans Thaxter.
“ **texanus** Horn,	“ variabilis Thaxter.
“ **tricolor** Dej.,	“ “ “
“ **velutinus** Duft.,	“ proliferans Thaxter.
“ **vestitus** F.,	“ fasciculata Peyritsch.
“ **viridicollis** Reiche,	“ variabilis Thaxter.
“ spp. indet.,	“ “ “
Clivina cordata Pz.,	“ Schizogenii Thaxter.
“ **dentifemorata** Pz.,	“ Clivinæ Thaxter.
“ **dentipes** Dej.,	“ “ “
Colpodes cæruleomarginatus, Chaud.,	“ elongata Thaxter.
“ **cyanonotus** Chaud.,	“ “ “
“ **duplex** Bates,	“ “ “
“ **grata** Bates,	“ “ “
“ **evanescens** Bates,	Rhachomyces longissimus Thaxter.
“ **incultus** Bates,	Laboulbenia elongata Thaxter.
“ **purpuripennis** Chaud.,	“ “ “
“ **sphodroides** Chaud.,	“ “ “
“ **petilus** Bates,	“ “ “
“ **tenuicornis** Chaud.,	“ “ “
“ spp. indet.,	“ “ “
Coptodera Championi Bates,	“ Coptoderæ Thaxter.
Crepidogaster bimaculata Boh.,	“ zanzibarina Thaxter.
Dolichus ? sp. indet.,	“ proliferans Thaxter.
Eudema tropicum Hope,	“ “ “

NAME OF HOST INSECT.	NAME OF PARASITE.
Eudema sp. indet.,	Laboulbenia proliferans Thaxter.
Galerita æquinoctialis Chaud.,	" decipiens Thaxter.
" " "	" mexicana Thaxter.
" **atripes** Lec.,	" Galeritæ Thaxter.
" **Janus** Fabr.,	" " "
" **leptodera** Chaud.,	" longicollis Thaxter.
" **mexicana** Dej.,	" Galeritæ Thaxter.
" " "	" melanotheca Thaxter.
" " "	" mexicana Thaxter.
" **nigra** Chev.,	" " "
" sp. indet.,	" decipiens Thaxter.
" "	" longicollis Thaxter.
Harpalus erythropus Dej.,	" filifera Thaxter.
" **pennsylvanicus** DeG.,	" arcuata Thaxter.
" " "	" conferta Thaxter.
" " "	" elegans Thaxter.
" " "	" Harpali Thaxter.
" **pleuriticus** Kirby	" polyphaga Thaxter.
Læmosthenes cavicola Sch.,	" elongata Thaxter.
Loxandrus spp. indet.,	" polyphaga Thaxter.
Macrochilus biguttatus Goeze.	" elongata Thaxter.
Morio Georgii Pal.,	" Morionis Thaxter.
Mormolyce phyllodes Hagenb.,	" Kunkeli (Giard).
" " "	" palmella Thaxter.
Nebria brunnea Duft.,	" Nebriæ Peyritsch.
" **gregaria** Fisch.,	" " "
" **pallipes** Say.	" " "
" **Sahlbergi** Fisch.,	" " "
" **villæ** Dej.,	" " "
Olisthopus parmatus Say,	" polyphaga Thaxter.
Omophron americanum Dej.,	" variabilis Thaxter.
" **limbatum** F.,	" fasciculata Peyritsch.
" sp. indet.,	" variabilis Thaxter.
Pachyteles luteus Hope,	Dimeromyces africanus Thaxter.
" **mexicanus** Chaud.,	Laboulbenia Pachytelis Thaxter.
Panagæus crucigerus Say,	" Panagæi Thaxter.
" **fasciatus** Say,	" " "
Patrobus longicornis Say,	" brachiata Thaxter.
" " "	" variabilis Thaxter.
" **tenuis** Say,	" brachiata Thaxter.
Pheropsophus æquinoctialis Linn.,	" Pheropsophi Thaxter.
" (?) **marginatus** Dej.,	" " "
" spp. indet.,	" " "
" " "	Enarthromyces indicus Thaxter.
Platynus æruginosus Dej.,	Laboulbenia parvula Thaxter.
" **affinis** Kirby,	" contorta Thaxter.
" **bicolor** Lec.,	" elongata Thaxter.
" **brunneomarginatus** Mann.,	" " "
" **cincticollis** Say,	" " "
" " "	" fumosa Thaxter.
" " "	Peyritschiella curvata Thaxter.
" " "	" minima Thaxter.
" **dissectus** Lec.,	Laboulbenia elongata Thaxter.
" **extensicollis** Say,	" "

Name of Host Insect.	Name of Parasite.
Platynus extensicollis Say,	Laboulbenia contorta Thaxter.
" " "	" gibberosa Thaxter.
" " "	" parvula Thaxter.
" " "	" paupercula Thaxter.
" " "	" recta Thaxter.
" " "	" scelophila Thaxter.
" " "	" variabilis Thaxter.
" **floridanus** Lec.,	" elongata Thaxter.
" **melanarius** Dej.,	" " "
" " "	" paupercula Thaxter.
" **ovipennis** Mann.,	" elongata Thaxter.
" **picticornis** Newm.,	" " "
" **pusillus** Lec.,	" " "
" **ruficornis** Lec.,	" " "
" **sinuatus** Dej.,	" " "
" **viduus** Pz.,	" anceps Peyritsch.
Pristonychus, see **Læmosthenes**.	
Pterostichus adoxus Say,	" variabilis Thaxter.
" **caudicalis** Say,	" " "
" **corvinus** Dej.,	" " "
" **erythropus** Dej.,	Peyritschiella geminata Thaxter.
" **luctuosus** Dej.,	" " "
" " "	Laboulbenia Pterostichi Thaxter.
" " "	" terminalis Thaxter.
" " "	" variabilis Thaxter.
" **mancus** Lec.,	" Pterostichi Thaxter.
" **patruelis** Dej.,	Peyritschiella geminata Thaxter.
" " "	Laboulbenia rigida Thaxter.
" **relictus** Newm.,	" variabilis Thaxter.
" **Sayi** Brullé,	" " "
" vel. affin. (S. Amer.)	" " "
Schizogenius ferrugineus Pz.,	" Schizogenii Thaxter.
" **lineolatus** Say,	" " "
Stenolophus fuliginosus Dej.,	" polyphaga Thaxter.
" **limbalis** Lec.,	" " "
" **ochropezus** Say,	" umbonata Thaxter.
Trechus chalybeus Mann.,	" vulgaris Peyritsch.

HALIPLIDÆ.

Cnemidotus muticus Lec.,	Hydræomyces Halipli Thaxter.
Haliplus ruficollis DeG.,	" " "

DYTISCIDÆ.

Bidessus granarius Aube,	Chitonomyces bidessarius Thaxter.
Desmopachria convexa Aube,	" aurantiacus Thaxter.
" " "	" borealis Thaxter.
Hydroporus spurius Lec.,	" marginatus Thaxter.
" " "	" rhyncostoma Thaxter.
" " "	" simplex Thaxter.
" " "	" uncinatus Thaxter.
Laccophilus hyalinus Dej.,	" paradoxus (Peyritsch).
" " "	" melanurus Peyritsch.
" **minutus** Sturm.,	" " "
" " "	" paradoxus (Peyritsch).

NAME OF HOST INSECT.	NAME OF PARASITE.
Laccophilus maculosus Germ.,	Chitonomyces affinis Thaxter.
" " "	" appendiculatus Thaxter.
" " "	" distortus Thaxter.
" " "	" hyalinus Thaxter.
" " "	" lichanophorus Thaxter.
" " "	" marginatus Thaxter.
" " "	" paradoxus (Peyritsch).
" " "	" rhyncostoma Thaxter.
" " "	" simplex Thaxter.
" " "	" spinigerus Thaxter.
" " "	" uncigerus Thaxter.
" " "	" uncinatus Thaxter.
" sp. indet..	" affinis Thaxter.
" " "	" marginatus Thaxter.
" " "	" paradoxus (Peyritsch).
" " "	" uncigerus Thaxter.

GYRINIDÆ.

Gyretes compressus Lec.,	Laboulbenia Guerinii Mont. and Robin.
" **sericeus** Lab.,	" " " "
Gyrinus affinis Aube,	" Gyrinidarum Thaxter.
" **analis** Say,	" " "
" **confinis** Lec.,	" " "
" **fraternus** Coup.,	" " "
" **plicifer** Lec.,	" " "
" **urinator** Illig.,	" " "
" **ventralis** Kirby,	" " "
Orectogyros heros Reg.,	" Oberthuri Giard.
" **Bedeli** Reg.,	" Orectogyri Thaxter.

HYDROPHILIDÆ.

Berosus striatus Say,	Ceratomyces contortus Thaxter.
" " "	" furcatus Thaxter.
" " "	" humilis Thaxter.
Hydrocombus fimbriatus Melsh.,	" rostratus Thaxter.
" " "	Zodiomyces vorticellarius Thaxter.
" **lacustris** Lec.,	" " "
" sp. indet.,	" " "
Philhydrus cinctus Say,	Ceratomyces rostratus Thaxter.
" **nebulosus** Say,	" " "
Tropisternus glaber Hb.,	" camptosporus Thaxter.
" " "	" confusus Thaxter.
" " "	" filiformis Thaxter.
" " "	" mirabilis Thaxter.
" **nimbatus** Say,	" confusus Thaxter.
" " "	" filiformis Thaxter.
" " "	" minisculus Thaxter.
" " "	" mirabilis Thaxter.
" **striolatus** Lec.,	" camptosporus Thaxter.

STAPHYLINIDÆ.

Actobius nanus Horn,	Teratomyces Actobii Thaxter.
" " "	" brevicaulis Thaxter.
" " "	Diplomyces Actobianus Thaxter.
Acylophorus flavicollis Sachs,	Teratomyces mirificus Thaxter.

Name of Host Insect.	Name of Parasite.
Acylophorus flavipes Lec.,	Teratomyces mirificus Thaxter.
" **pronus** Er.,	" " "
Bledius armatus Er.,	Cantharomyces occidentalis Thaxter.
" **assimilis** (ms. name ?)	" Bledii Thaxter.
" **basalis** Lec.,	"Amorphomyces" floridanus Thaxter.
" **emarginatus** Say,	Haplomyces virginianus Thaxter.
" **ornatus** Lec.,	" californicus Thaxter.
" **rubiginosus** Er.,	" texanus Thaxter.
Cryptobium bicolor Grav.,	Corethromyces Cryptobii Thaxter.
" **pallipes** Grav.,	" " "
Deleaster dichrous Grav.,	Idiomyces Peyritschii Thaxter.
Falagria dissecta Er.,	Amorphomyces Falagriæ Thaxter.
" " "	Dimorphomyces denticulatus Thaxter.
" " "	" muticus Thaxter.
Lathrobium angulare Lec.,	Rhadinomyces pallidus Thaxter.
" **collare** Ehr.,	Corethromyces jacobinus Thaxter.
" **fulvipenne** Grav.,	Rhachomyces pilosellus (Robin).
" " "	Rhadinomyces pallidus Thaxter.
" **jacobinum** Lec.,	Corethromyces jacobinus Thaxter.
" **longiusculum** Grav.,	Rhachomyces Lathrobii Thaxter.
" **nitidulum** Lec.,	Corethromyces setigerus Thaxter.
" " "	Rhadinomyces subulatus Thaxter.
" " "	Sphaleromyces Lathrobii Thaxter.
" **punctulatum** Lec.,	Ceratomyces terrestris Thaxter.
" " "	Rhadinomyces cristatus Thaxter.
" " "	" pallidus Thaxter.
" " "	Sphaleromyces Lathrobii Thaxter.
" **tenue** Lec.,	Corethromyces setigerus Thaxter.
Lathrobium vel affin.?	Rhachomyces arbuscularis Thaxter.
Othius fulvipennis Fabr.,	" furcatus Thaxter.
Pæderus littorarius Grav.,	Laboulbenia cristata Thaxter.
" **obliteratus** Lec.,	" " "
" **ruficollis** Fabr.,	" " "
" spp. indet.,	" " "
Philonthus æqualis Horn.	" Philonthi Thaxter.
" **cunctans** Horn.	" " "
" **debilis** Grav.,	Dichomyces furciferus Thaxter.
" " "	" inæqualis Thaxter.
" " "	Peyritschiella nigrescens Thaxter.
" " "	Laboulbenia Philonthi Thaxter.
" **furvus** Nord.,	" " "
" **micans** Grav.,	" " "
" **sordidus** Grav.,	Dichomyces princeps Thaxter.
" spp. indet.,	Laboulbenia Philonthi Thaxter.
Pinophilus densus Lec.,	Sphaleromyces occidentalis Thaxter.
" **latipes** Ehr.,	Chætomyces Pinophili Thaxter.
Quedius ferox Lec.,	Teratomyces Quedianus Thaxter.
" **vernix** Lec.,	Laboulbenia Quedii Thaxter.
Sunius longiusculus Mann.,	Camptomyces melanopus Thaxter.
" " "	Compsomyces verticillatus Thaxter.
" **prolixus** Ehr.,	Camptomyces melanopus Thaxter.
" " "	Monoicomyces insignis Thaxter.
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Trogophlæus spp. indet.,	Cantharomyces pusillus Thaxter.
Xantholinus obsidianus Melsh.,	Dichomyces infectus Thaxter.

NAME OF HOST INSECT.	NAME OF PARASITE.
COCCINELLIDÆ.	
Chilocorus bivulnerus Muls., ...	Stigmatomyces virescens Thaxter.

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DIOPSIDÆ.	
Diopsis thoracica Westw., ...	Laboulbenia Diopsis Thaxter.
" " "	Rhizomyces ctenophorus Thaxter.
DROSOPHILIDÆ.	
Drosophila nigricornis Loew., ...	Stigmatomyces entomophilus (Peck).
" **funebris** L., ...	" " "
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Megistopoda Westwoodii Kol., ...	" " "
Nycteribia Dufourii, ...	" " "

NEUROPTERA.

TERMITES.	
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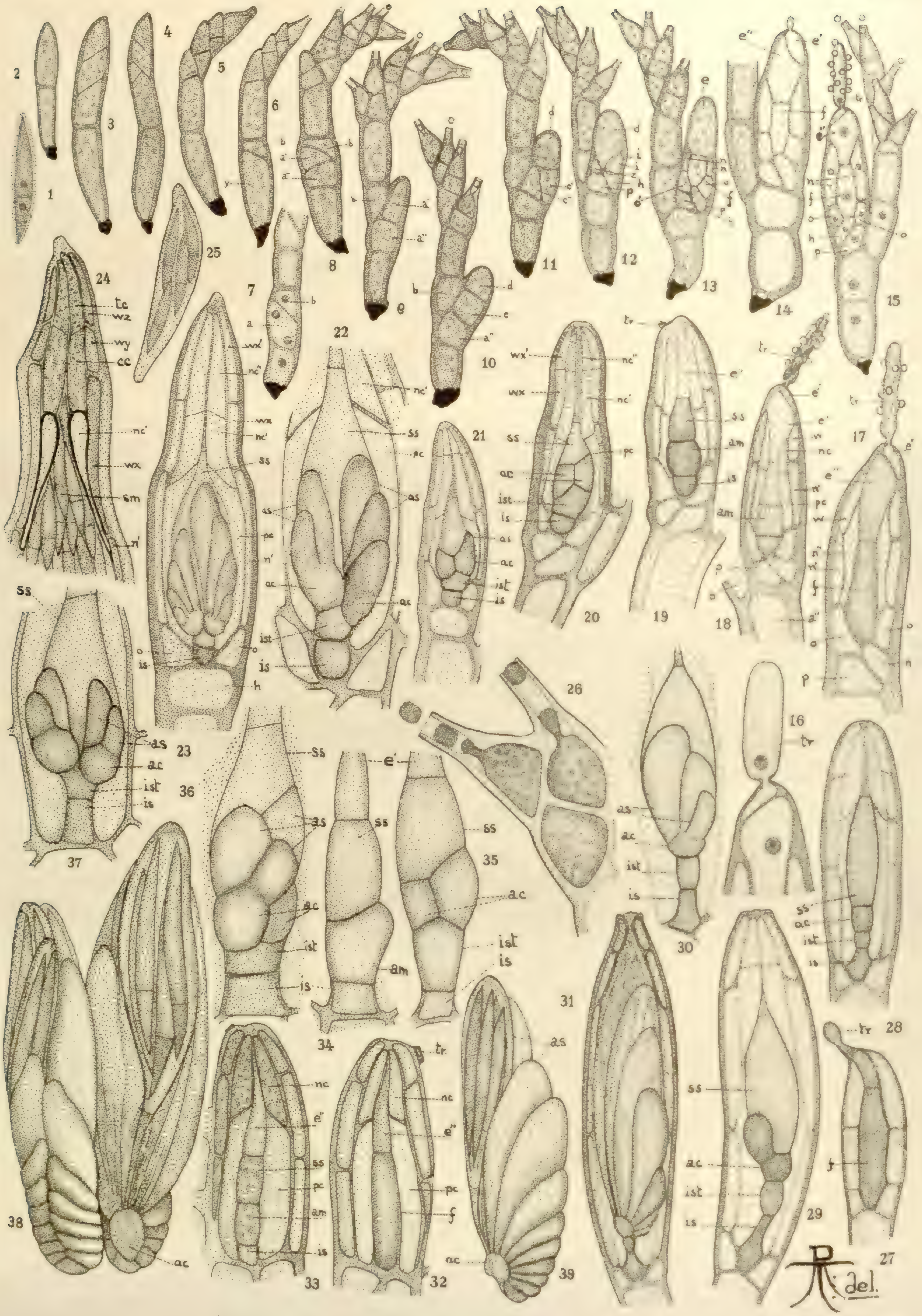
PLATE I.



THAXTER—MONOGRAPH OF LABOULBENIACEÆ

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DESCRIPTIONS OF THE PLATES.

NOTE. — The following figures have been reproduced, by photo-lithography and the heliotype process, from ink drawings made with a camera lucida, and have been slightly reduced from the originals. The letters and numbers following the descriptions of the figures indicate the combinations of Zeiss objectives and eye-pieces used in each case.

DESCRIPTION OF PLATE I.

Stigmatomyces Baeri Peyritsch.

Figs. 1 to 15. Successive stages from the spore to the formation of the mature female organ. See p. 218. All J 2.

Fig. 16. Terminal portion of young perithecium, showing nucleated trichogyne and trichophoric cell before fertilization. J 4.

Fig. 17. Young perithecium in which fertilization has just been accomplished. J 2.

Figs. 18, 19. Young perithecium after fertilization. The first divisions of the carpogenic cell have taken place. J 2.

Fig. 20. A more advanced condition in which the ascogonium has divided into four ascogenic cells (**ac**) and a secondary inferior supporting cell (**ist**). J 2.

Fig. 21. A somewhat more advanced condition of the same. J 2.

Fig. 22. A more advanced condition in which the asci have begun to bud from the ascogenic cells. A slightly oblique lateral view. J 2.

Fig. 23. A still more advanced condition showing the further development of the perithecial cells and their relations to the ascogenic and supporting cells. An optical section seen antero-posteriorly. J 2.

Fig. 24. Terminal portion of a mature perithecium just before the first spore discharge. The upper and lower series of canal cells (**tc** and **c**) are still intact, the latter beginning to be pressed apart by the spore mass (**sm**). The inferior canal-cells (**nc**) have become somewhat modified through the thickening of their walls, and form a diaphragm between the general cavity of the perithecium and that of the neck. J 2.

Fig. 25. A single four-spored ascus isolated. J 2.

Fig. 26. Terminal portion of an appendage showing two antheridial cells with antherozoids both mature and in process of formation. J 12.

Peyritschiella geminata Thaxter.

Fig. 27. Young perithecium, in which the trichogyne has not been fertilized. $\frac{1}{12}$ 4.

Fig. 28. Young perithecium after fertilization in which the carpogenic cell has divided into the inferior and superior supporting cells while the ascogonium has divided into a single ascogenic cell (**ac**) and a secondary inferior supporting cell (**ist**). $\frac{1}{12}$ 4.

Figs. 29, 30. More mature condition in which the asci have begun to bud from the ascogenic cell. $\frac{1}{12}$ 4.

Fig. 31. Mature perithecium showing the ascogenic cell and the mass of asci developed from it still supported by the two inferior supporting cells, which will soon be wholly destroyed, leaving the ascus mass free within the cavity of the perithecium. $\frac{1}{12}$ 2.

Laboulbenia elongata Thaxter.

Fig. 32. Young perithecium after fertilization, the insertion only of the trichogyne being visible (**tr**). The carpogenic cell (**f**) has not yet divided. $\frac{1}{12}$ 2.

Fig. 33. The carpogenic cell has divided into the inferior and superior supporting cells and the ascogonium. $\frac{1}{12}$ 2.

Fig. 34. The ascogenic apparatus seen at a stage slightly more advanced than in the previous figure. The ascogonium has begun to grow upward on the right before the formation of septa. J 4.

Fig. 35. Ascogenic apparatus in which the ascogonium has divided into two ascogenic cells (**ac**) and a secondary inferior supporting cell (**ist**). J 4.

Fig. 36. A more advanced stage, in which the asci (**as**) have begun to bud from the ascogenic cells. J 4. Figs. 32–36 represent lateral views.

Fig. 37. Antero-posterior view of the ascogenic apparatus, showing the two ascogenic cells lying side by side and beginning to separate while the asci have already begun to bud. D 12.

Fig. 38. Two ascogenic cells with asci attached seen as they lie free within the cavity of the perithecium. That at the left seen dorsally, that at the right ventrally. J 2.

Fig. 39. Ascogenic cell with attached asci seen sidewise as it lies free within the cavity of the perithecium. J 2.

A detailed description of the figures on this plate will be found on pages 218–228 of the text. The letters correspond in all the figures, and the corresponding structures are as follows: (**c**) primordial cell of perithecium proper; (**d**) primordial cell of procarpe; (**o, o′**) basal cells of perithecium; (**i, i, z**) primordial cells of perithecial wall-cells, the parietal, and the canal-cells; (**f**) carpogenic cell; (**e″**) trichophoric cell; (**e′**) base of trichogyne (**tr**); (**nc′, w, wx, wy, wz**) wall-cells of the perithecium; (**wz**) lip-cells; (**pc**) parietal cells of perithecium; (**nc′, cc, tc**) canal-cells of perithecium; (**p**) stalk-cell of perithecium; (**h**) secondary stalk-cell; (**o′**) posterior basal cell; (**o**) one of two anterior basal cells; (**nn**) primordial wall-cells; (**am**) ascogonium; (**is**) inferior supporting cell; (**ss**) superior supporting cell; (**ist**) secondary inferior supporting cell; (**ac**) ascogenic cells; (**as**) asci; (**sm**) ascus mass.

THAXTER—MONOGRAPH OF LABOULBENIACEÆ.

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DESCRIPTION OF PLATE II.

Teratomyces mirificus Thaxter.

Fig. 1. Young individual. A young perithecium in the centre bears terminally a highly developed branching trichogyne. D 2.

Laboulbenia cristata Thaxter.

Fig. 2. Young perithecium with antheridia above at the right. The darker axile cell the carpogonium, above it the trichophoric cell terminated by the trichogyne, on which are several antherozoids. Leitz oil $\frac{1}{12}$ 4.

Fig. 3. Young individual with much more highly developed trichogyne, many of the cells of which are distinctly nucleated. The cells of the dark rigid appendages at the left also nucleated. D 2.

Rhadinomyces pallidus Thaxter.

Fig. 4. Young individual with simple trichogyne, on which are numerous antherozoids. D 4.

Laboulbenia elongata Thaxter.

Fig. 5. Young individual with well-developed trichogyne, the tips of which are spirally twisted. A fertile branch bearing numerous antheridia projects across the basal cell of the trichogyne. D 2.

Rhachomyces lasiophorus Thaxter.

Fig. 6. Young perithecium with branched trichogyne; at its base several young sterile appendages, and at the left an antheridium. D 4.

Laboulbenia elongata Thaxter.

Fig. 7. Abnormal form on which no perithecium has developed, but in its place the usual blackened insertion-cell bearing sterile and fertile appendages, the latter with great numbers of antheridia. D 2.

Fig. 8. Abnormal form in which the perithecium at the right has not developed, the cells at its base having sent out branches on which are numerous antheridia. D 2.

Laboulbenia paupercula Thaxter.

Fig. 9. Abnormal form in which the ascogenic cells have not developed, while the cells at the base of the perithecium have sent up within it sterile branches, the tips of which project through the terminal pore. D 2.

Laboulbenia parvula Thaxter.

Fig. 10. Specimen in which the perithecium has been broken off while the cells at its base have sent up within it numerous sterile branches. D 2.

Dichomyces princeps Thaxter.

Fig. 11. Group of asci isolated by crushing. The three terminal asci show ascospores within and all are adherent to the remains of the ascogenic cell. Leitz $\frac{1}{12}$ 2.

Peyritschiella curvata Thaxter.

Fig. 12. Antheridium at the right, showing terminal pointed slightly inflated receptacle into which the antherozoids are discharged from the cells just below it. Leitz oil $\frac{1}{12}$ 4.

Laboulbenia elongata Thaxter.

Fig. 13. Spore showing nuclei. $\frac{1}{12}$ 2.

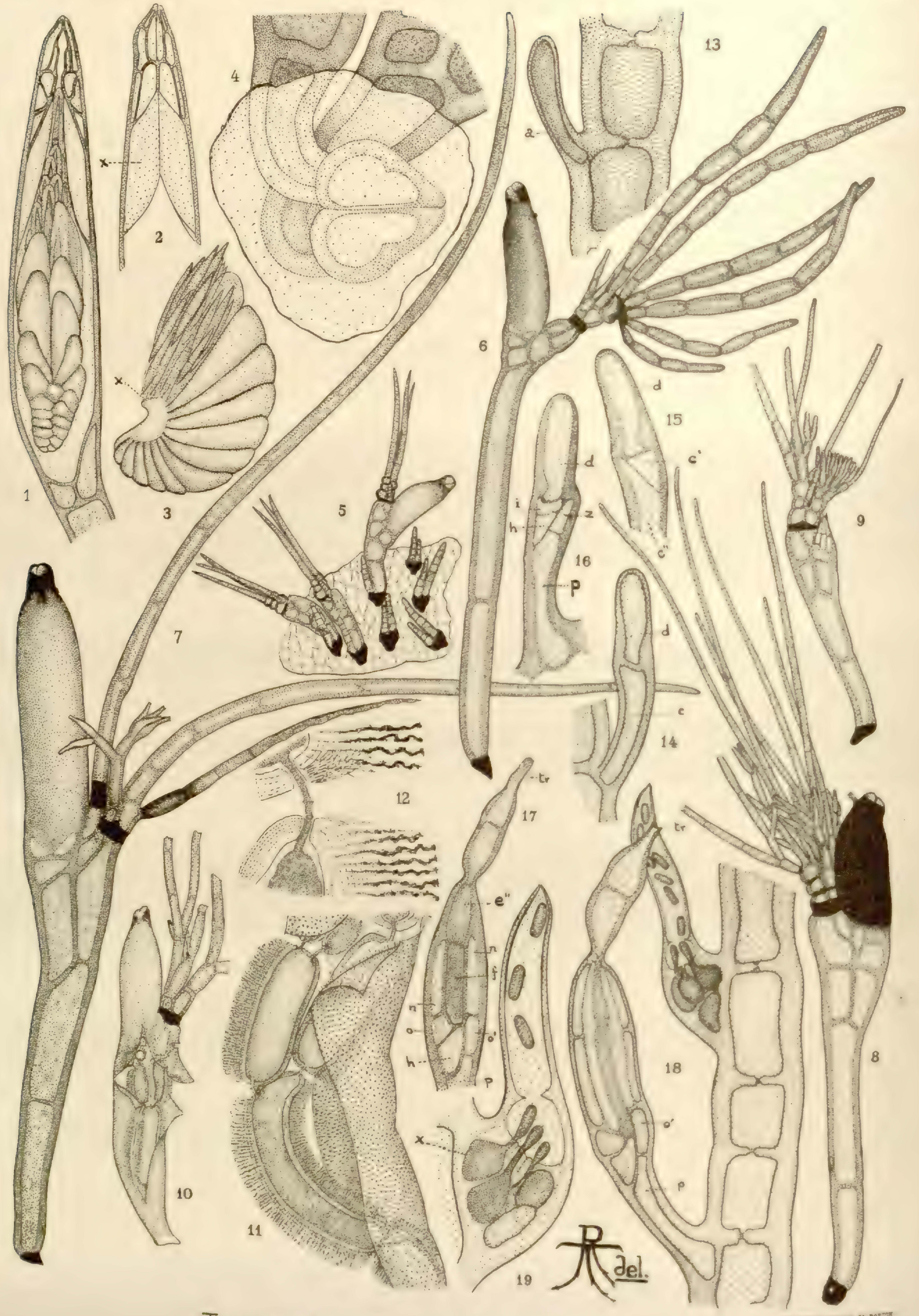
Fig. 14. Terminal portion of perithecium showing structure of lip-cells (**lp**), insertion of trichogyne (**tr**), and "valve" of posterior lip-cell (**x**). $\frac{1}{12}$ 4.

Fig. 15. Portion of fertile branch bearing an antheridium, its structure shown in optical section. $\frac{1}{12}$ 4.

Fig. 16. Protoplasmic connections of the "stalk-cell" and basal cells of the perithecium indicating the successive origin of each. Drawn from a specimen in which the cells had been treated with potash and stained with eosin. The appendage lies at the left. J 2.

Fig. 17. A specimen similarly treated and viewed from the opposite side. The appendage lies at the right. In both figures the stalk-cell is marked (**p**), the posterior basal cell (**o′**), the secondary stalk-cell (**h**), the anterior basal cells, left (**g**), right (**d**), and the four basal wall-cells of the perithecium (**e, i, f, j**), the cell (**j**) not being visible in fig. 17. J 2.

Fig. 18. A specimen similarly treated, slightly crushed so as to separate the basal cells without destroying the ascus mass and the inferior supporting cell, the protoplasmic connection of which with the secondary stalk-cell (**h**) is unbroken, as well as the connections of the two anterior basal cells with the parietal (**pc**) and wall (**f, j**) cells above them. The protoplasmic portions only of these cells are indicated, the lettering corresponding to that of the two previous figures, except that (**is**) represents the inferior supporting cell of the ascus apparatus, (**am**) the ascus mass and ascogenic cells, and (**pc**) the parietal cells of the perithecium.



THAXTER–MONOGRAPH OF LABOULBENIACEÆ.

DESCRIPTION OF PLATE III.

Sphaleromyces Lathrobii Thaxter.

Fig. 1. Mature perithecium seen in optical section, showing dorsal view, the ascogenic cell with attached asci lying free in the cavity of the perithecium. The ascogenic cell itself lies on the opposite side, and is not seen in the figure. $\frac{1}{12}$ 2.

Fig. 2. Terminal portion of a somewhat younger perithecium seen laterally in optical section. $\frac{1}{12}$ 2.

Rhizomyces ctenophorus Thaxter.

Fig. 3. Ascogenic cell with attached asci showing oblique position of the mass as it lies free in the cavity of the perithecium. Only a small portion of the spore mass is shown, which fills the cavity of the perithecium above the ascogenic cell, the spores being freed through the sloughing off of the asci as they mature from the upper portion of the ascogenic cell (at **x**), and the absorption of the ascus wall. J 2.

Laboulbenia Hageni Thaxter.

Fig. 4. Portion of the soft integument from the abdomen of a white ant, bearing a pair of individuals, inverted so as to show the attachment of the foot as it appears when viewed from below. J 4.

Laboulbenia inflata Thaxter.

Fig. 5. Portion of the hard chitinous integument from the leg of Bradycellus, showing seven pairs of individuals in various stages of development, and illustrating the abortion, characteristic of this species, of one member of the pair. C 2.

Laboulbenia Diopsis Thaxter.

Fig. 6. Mature individual of average dimensions. A 12.

Laboulbenia proliferans Thaxter. var. *liberiana.*

Fig. 7. Mature individual of the Liberian variety, the proliferous appendage having the black indurated base. A 12.

Laboulbenia Aspidoglossæ Thaxter.

Figs. 8, 9. Mature and young individuals. A 12.

Laboulbenia elongata Thaxter.

Fig. 10. Individual treated with potash, showing the general envelope ruptured by longitudinal and transverse slits exposing the cells within. A 4.

Fig. 11. Portion of an individual similarly treated. Cells II, III, and VI seen in optical section protruding from the ruptured envelope. The dots on the surface of the latter correspond to the points of attachment of the fibrillæ which arise from the inner layers of the cell-walls on the surfaces next to the envelope. The protoplasmic connection of the different cells is indicated. D 2.

Fig. 12. The adjacent ends of cells III and IV from an individual similarly treated, showing fibrillæ and protoplasmic connection. $\frac{1}{12}$ 12.

Enarthromyces indicus Thaxter.

Fig. 13. Portion of the axis of the receptacle, showing the bud (**a**) from which the perithecium and its stalk-cell are formed. D 4.

Fig. 14. The bud (**a**) of the previous figure has become divided by a transverse partition into two superposed cells (**c** and **d**). D 4.

Fig. 15. The cell (**c**) of the previous figure has become divided into a lower cell (**c**″), the stalk-cell, and an upper cell (**c**′), the primordial cell of the perithecium, the cell (**d**) being the primordial cell of the procarpe. D 4.

Fig. 16. The cell (**c**′) has divided into four cells, which are beginning to grow up around the base of (**d**). D 4.

Fig. 17. A more advanced stage. The cells (**i**, **i**) of the previous figure are divided by transverse septa and have grown up around the base of the cell (**d**), which has now developed into a mature procarpe, (**f**) the carpogenic cell, (**e**″) the tricophoric cell, (**tr**) the trichogyne, the narrow tip of which is alone receptive. $\frac{1}{12}$ 2.

Fig. 18. Portion of the axis of a receptacle showing relative position of the young perithecium and of the antheridium. The receptive tip of the trichogyne has collapsed, fertilization having presumably been accomplished. $\frac{1}{12}$ 2.

Fig. 19. Antheridium seen in optical section showing antherozoids mature in its cavity and in process of formation from its antheridial cells. $\frac{1}{12}$ 4

THAXTER—MONOGRAPH OF LABOULBENIACEÆ.

DESCRIPTION OF PLATE IV.

Rhizomyces ctenophorus Thaxter.

Fig. 1. Mature individual, showing a fragment of the host's integument adherent between the rhizoids and the basal cell. A 12.

Fig. 2. Spore. D 4.

Fig. 3. Rhizoids, but slightly broken, from another individual. D 2.

Fig. 4. Portion of axis of antheridial appendage showing antheridial branch with three antheridia at its base, and sterile terminal branchlets. $\frac{1}{12}$ 2.

Laboulbenia Orectogyri Thaxter.

Fig. 5. Mature individual. A 12.

Rhachomyces arbusculus Thaxter.

Fig. 6. Mature individual. A 12.

Fig. 7. Spore. D 4.

Enarthromyces indicus Thaxter.

Fig. 8. Mature individual with three mature and three aborted perithecia. A 12.

Fig. 9. Spore. D 4.

Fig. 10. Tip of young perithecium, showing cell-structure. D 4.

Fig. 11. Process from one of dorsal lip-cells of mature perithecium. D 4.

Dimeromyces africanus Thaxter.

Figs. 12, 13. Mature female individuals with one and three mature perithecia respectively. A 12.

Fig. 14. Young female individual, showing origin of perithecia and appendages. A 12.

Fig. 15. Mature male individual with two antheridia. A 12.

Fig. 16. Optical section of antheridium, showing mature antherozoids free within the cavity of the antheridium neck and in process of formation from the antheridial cells. $\frac{1}{12}$ 4.

Fig. 17. Young perithecium, showing (remains of ?) trichogyne. $\frac{1}{12}$ 2.

DESCRIPTION OF PLATE V.

Dimorphomyces muticus Thaxter.

Fig. 1. An old female individual in which four new perithecia are developing. One of the two primary perithecia is shown projecting to the left, and within it two fully developed male individuals. Posterior view. D 4.

Fig. 2. Male and female individuals *in situ* on edge of portion of abdominal ring of host. The male at the left; both viewed posteriorly and illustrating the juxtaposition of the sexes at the point of infection. The ascus group shown in left perithecium. D 4.

Fig. 3. Mature female individual with but two perithecia seen in optical section with ascus groups. Anterior view. D 4.

Fig. 4. Young female individual seen sidewise, its posterior face with the sterile terminal cells of the receptacle at the right. Of the two young perithecia the larger bears a terminal branched trichogyne, to which several antherozoids are affixed. D 12.

Fig. 5. Male and female individual developed from the same spore pair at the point of infection. The female at the right has two young perithecia with terminal trichogynes on which are several antherozoids. Posterior views. D 12.

Fig. 6. Young female individual seen sideways. D 12.

Fig. 7. Tip of perithecium. D 12.

Figs. 8 and 9. Two mature male individuals showing discharge of antherozoids. D 12.

Fig. 10. Spore. D 12.

Dimorphomyces denticulatus Thaxter.

Fig. 11. Mature female individual. View in part anterior. D 4.

Fig. 12. Mature female individual seen posteriorly, a third young perithecium projecting at the right. D 4.

Fig. 13. Tip of perithecium. D 12.

Figs. 14 and 15. Two male individuals with antherozoids. D 12.

Fig. 16. Spore. D 12.

Amorphomyces Falagriæ Thaxter.

Fig. 17. Male and female individual developed from the same spore pair at the point of infection. The perithecium of the female shown in optical section with the nucleated asci arising from the long ascogenic cell at the left. The ascus mass is viewed obliquely sidewise. The spore mass in the terminal portion of the perithecium consists of spore pairs freed through the absorption of the ascus walls. D 4.

Fig. 18. Female individual viewed anteriorly. The asci are shown arising alternately in a double row from the ascogenic cell, which lies behind. D 4.

Fig. 19. Mature female individual viewed sidewise. Many of the spore pairs in the terminal portion have begun to germinate, their blackened haustoria directed upward. D 4.

Fig. 20. Male and female individuals developed from the same spore pair. The female at the left terminated by a branching trichogyne, the carpogonium and trichophoric cell both distinctly nucleolated. The male at the right shows antherozoids before discharge. D 12.

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Fig. 21. Female individual before development of trichogyne. D 12

Fig. 22. Young female individual showing first three septa. D 12.

Fig. 23. Germinating spore pair, the male at the right. D 12.

Fig. 24. Terminal portion of young female individual with branching trichogyne on which is a single antherozoid. D 12.

Fig. 25. Ascus mass, showing origin of asci from ascogenic cell at the left. Leitz oil $\frac{1}{12}$ D. Figs. 17–25 drawn from living material.

Fig. 26. A view similar to the last, the asci somewhat shrunken by glycerine. $\frac{1}{12}$ D.

Fig. 27. Asci adhering to lower part of ascogenic cell, isolated from perithecium by crushing and treated with glycerine. The asci have been broken from the upper portion. Leitz oil. $\frac{1}{12}$ D.

Fig. 28. Ascus mass with ascogenic cell viewed anteriorly. The view opposite to that seen in fig. 18. D 4.

Fig. 29. Spore pair. The "male spore" at the left is slightly smaller. D 12.

Amorphomyces floridanus Thaxter.

Fig. 30. Mature individual. D 4.

DESCRIPTION OF PLATE VI.

Camptomyces melanopus Thaxter.

Figs. 1, 2. Mature individuals, posterior and nearly anterior views. D 2.

Fig. 3. Young individual with trichogyne and antherozoids. D 4.

Fig. 4. Young perithecium, showing trichogyne with antherozoids *in situ*, and large central carpogenic cell. D 12.

Figs. 5, 6. Lateral and anterior views of antheridium. D 12.

Peyritschiella geminata Thaxter.

Fig. 7. Mature individual with two terminal perithecia. D 2.

Fig. 8. Mature individual with single terminal perithecium. D 2.

Fig. 24. Spore. D 4.

Peyritschiella curvata Thaxter.

Fig. 9. Mature individual with antheridium at the right. D 2.

Fig. 10. Mature individual with antheridium at the left. D 2.

Fig. 11. Germinating spore. D 4.

Figs. 12–15. Successive stages in development. D 4.

Fig. 16. Young individual, the antheridium at the right, the immature perithecium terminated by the small trichogyne. D 4.

Fig. 17. Spore. D 4.

Fig. 18. Perithecium seen in section with contained ascus mass. No spores have been discharged, and the canal-cells of the tip are not yet destroyed. Leitz oil $\frac{1}{12}$ 2.

Peyritschiella minima Thaxter.

Figs. 19, 20. Two mature individuals, the antheridium shown (in 19) at the right. D 2.

Fig. 21. *nec del.*

Peyritschiella nigrescens Thaxter.

Figs. 22, 23. Mature specimen seen from both sides, the antheridium at the right in (23).

Fig. 24. See *sub P. geminata.*

Dichomyces furciferus Thaxter.

Fig. 25. Mature individual, posterior view, showing antheridia. D 2.

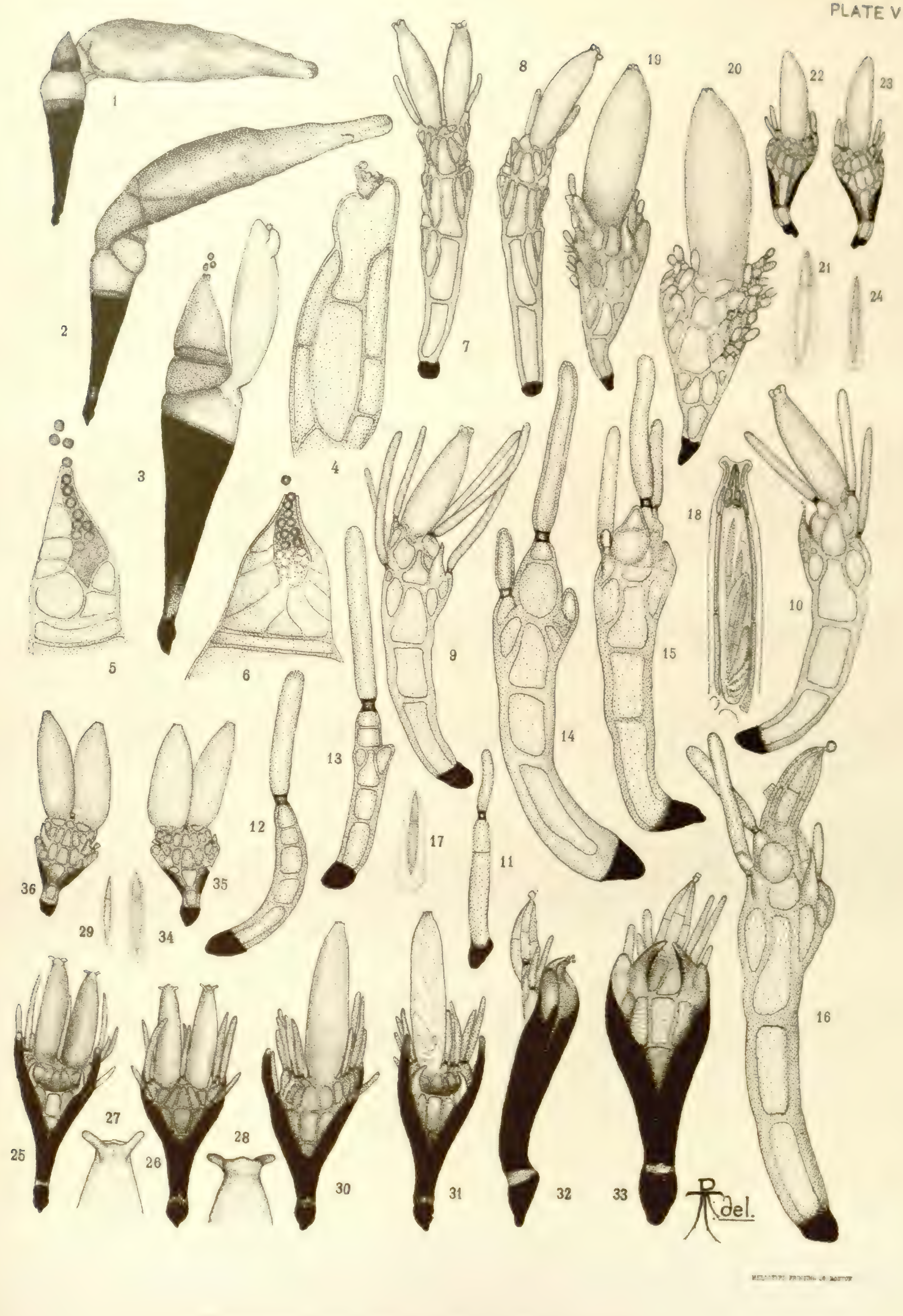
Fig. 26. Mature individual, anterior view. D 2.

Fig. 27. Tip of perithecium, posterior view. D 12.

Fig. 28. Tip of perithecium, anterior view. D 12.

Fig. 29. Spore. D 4.

PLATE VI.



THAXTER—MONOGRAPH OF LABOULBENIACEÆ.

Dichomyces inæqualis Thaxter.

Fig. 30. Mature individual, anterior view. D 2.

Fig. 31. Mature individual, posterior view, showing antheridia. D 2.

Fig. 32. Young individual, seen laterally; antheridium at the right discharging antherozoids; the young perithecium terminated by a small trichogyne, on which is a single antherozoid. D 4.

Fig. 33. The same, posterior view. D 4.

Fig. 34. Spore. D 4.

Dichomyces infectus Thaxter.

Figs. 35, 36. Anterior and posterior view of the same specimen. D 2.

DESCRIPTION OF PLATE VII.

Haplomyces californicus Thaxter.

Figs. 1, 2. Mature individuals. D 2.

Fig. 3. Antheridium enlarged. D 4.

Fig. 4. Spore. D 4.

Haplomyces texanus Thaxter.

Fig. 5. Nearly mature individual with hyaline receptacle. D 2.

Fig. 6. Mature individual. The sub-basal cell of the receptacle and the basal cell of the antheridium deeply blackened. D 2. Fig. 2*a*. Spore.

Haplomyces virginianus Thaxter.

Figs. 7 and 8. Two mature individuals. D 2.

Fig. 9. Antheridium enlarged. D 12.

Fig. 10. Spore. D 4.

Cantharomyces pusillus Thaxter.

Fig. 11. Immature individual, the base of the trichogyne still adherent near the tip on the inner side. D 4.

Figs. 12, 13. Two mature individuals, with simple and branched appendage. D 2.

Fig. 14. Two spores. D 4.

Cantharomyces occidentalis Thaxter.

Figs. 15, 16. Two mature individuals: the tips of the appendages broken. D 2.

Cantharomyces Bledii Thaxter.

Fig. 17. Mature individual. D 2.

Fig. 18. Mature individual, the sub-basal cell of receptacle partly blackened and producing two perithecia. D 2.

Fig. 19. Germinating spore. D 4.

Fig. 20. Young individual, with remains of trichogyne. D 4.

Fig. 21. Young individual: the immature perithecium consisting of two superposed cells projecting at the left. D 4.

Fig. 22. Antheridium enlarged. D 12.

Fig. 23. Spore. D 4.

Fig. 24. Young individual from which the perithecium has not yet begun to develop. D 4.

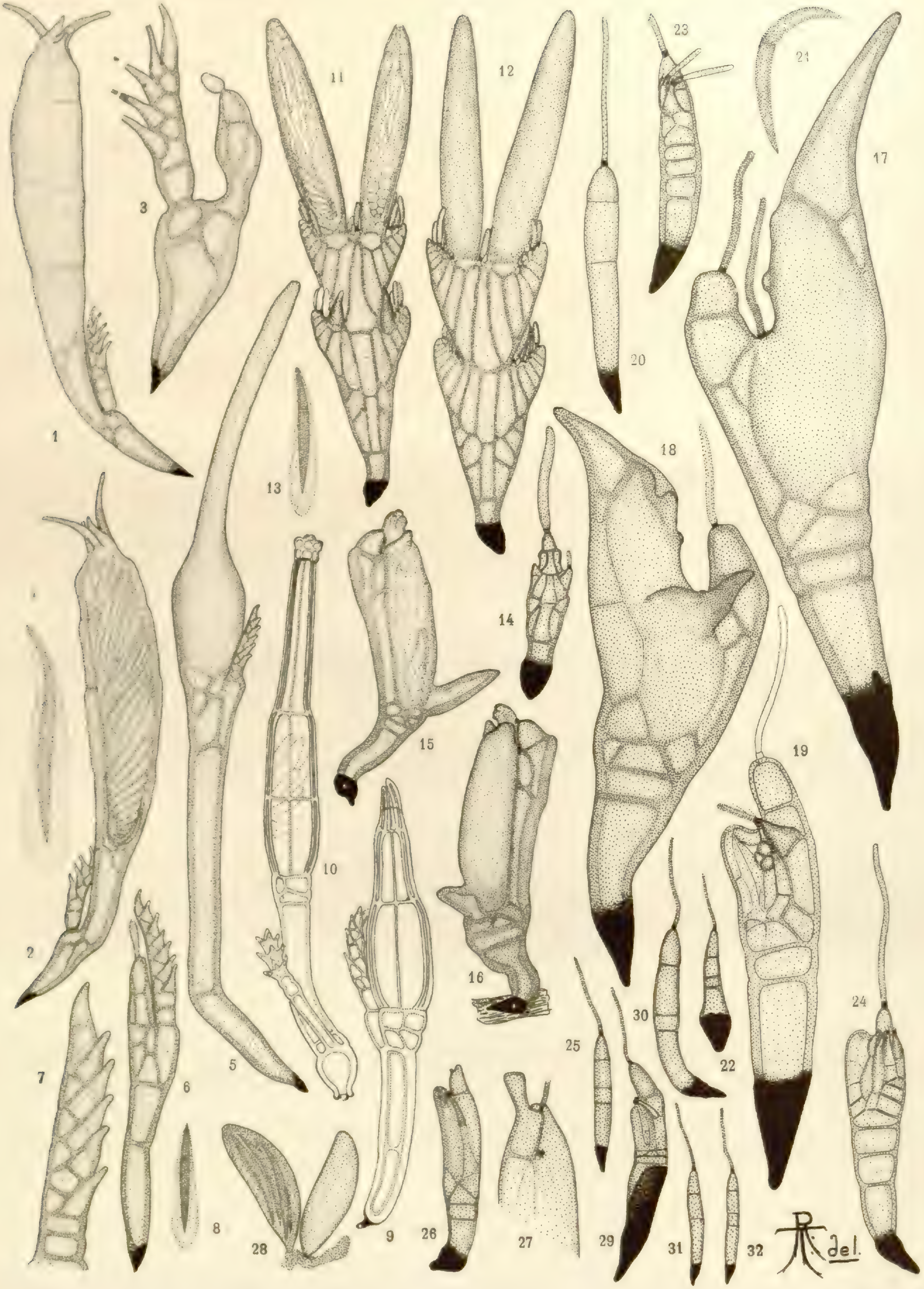
Eucantharomyces Atrani Thaxter.

Fig. 25. Nearly mature individual (the tip of the antheridium supplied). D 2.

Fig. 26. Younger individual. D 2.

Fig. 27. Antheridium enlarged. D 4.

THAXTER—MONOGRAPH OF LABOULBENIACEÆ.



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THAXTER—MONOGRAPH OF LABOULBENIACEÆ.

DESCRIPTION OF PLATE VIII.

Stigmatomyces virescens Thaxter.

Figs. 1, 2. Two mature individuals (2) showing spore and ascus mass. A 12.

Fig. 3. Young individual, the antheridium with discharged antherozoids at the left; the young perithecium with terminal trichogyne at the right. D 4.

Fig. 4. Spore. D 4.

Stigmatomyces entomophilus (Peck) Thaxter.

Fig. 5. Mature individual. A 12.

Fig. 6. Young individual with antheridium at the right and young perithecium with terminal trichogyne at the left. D 4.

Fig. 7. Antheridium enlarged. D 12.

Fig. 8. Spore. D 4.

Stigmatomyces Baeri (Knoch) Peyritsch.

Fig. 9. Mature individual (after Peyritsch).

Helminthophana Nycteribiæ Peyritsch.

Fig. 10. Mature individual (after Peyritsch).

Dichomyces princeps Thaxter.

Fig. 11. Mature individual, posterior view. D 2.

Fig. 12. Mature individual, anterior view. D 12.

Fig. 13. Spore. D 4.

Fig. 14. Young individual.

Chitonomyces spinigerus Thaxter.

Figs. 15, 16. Two mature individuals. D 2.

Chitonomyces paradoxus Peyritsch.

Figs. 17, 18. Two individuals seen from opposite sides. D 2.

Fig. 19. Young individual seen in optical section. The ascogenic cell has divided into three parts, and seems to be connected with the base of a trichogyne (?) The perithecium has begun to grow out laterally at the left. $\frac{1}{12}$ 2.

Fig. 20. Young individual, showing first cell divisions. D 4.

Fig. 21. Spore. D 4.

Hydræomyces Halipli Thaxter.

Fig. 22. Young individual, showing first divisions. D 4.

Fig. 23. Young individual in which the lower appendages have developed. D 4.

Fig. 24. Young individual, the three lower appendages with their basal cells at the right; at the left the young perithecium, and between them the ascogenic cell and trichophoric cell. Leitz oil $\frac{1}{12}$ 2.

Chitonomyces marginatus Thaxter.

Fig. 25. Young individual, showing first divisions. D 4.

Fig. 26. Young individual in which the terminal cell of the receptacle has just begun to proliferate. D 4.

Fig. 27. Terminal portion of young individual in which the proliferation is completed without having become blackened. D 12.

Fig. 28. Asci with ascospores. D 12.

Chitonomyces affinis Thaxter.

Figs. 29, 30. Young individuals. D 4.

Chitonomyces minor Thaxter.

Figs. 31, 32. Young individuals, showing first divisions. D 4.

THAXTER--MONOGRAPH OF LABOULBENIACEÆ.

DESCRIPTION OF PLATE IX.

Corethromyces Cryptobii Thaxter.

Fig. 1. Mature individual. The inner main appendage broken off at its base, the secondary appendages more or less broken. A 12.

Fig. 2. Young individual slightly crushed to show three main appendages with young perithecium terminated by remains of a branched trichogyne. A 12.

Corethromyces jacobinus Thaxter.

Fig. 3. Mature individual. A 12.

Fig. 4. Immature individual, showing position of antheridial branches. A 12.

Fig. 5. Single antheridial branch with two discharged antherozoids. D 12.

Corethromyces setigerus Thaxter.

Fig. 6. Nearly mature individual. The tips of the appendages are broken off. A 12.

Rhadinomyces pallidus Thaxter.

Fig. 7. Mature individual, developing a second perithecium. A 12.

Fig. 8. Mature individual of typical form. A 12.

Fig. 9. Antheridial branch. D 12.

Fig. 10. Mature individual of larger form (var. a), the branches mostly sterile. A 12.

Fig. 11. Spore of fig. 10. D 4.

Rhadinomyces cristatus Thaxter.

Fig. 12. Mature individual with two perithecia, one immature. A 12.

Fig. 13. Terminal portion of mature perithecium seen in optical section, the canal-cells having been destroyed. $\frac{1}{12}$ 4.

Fig. 14. Antheridial branch with discharged antherozoids. D 12.

Fig. 15. Spore. D 4.

Idiomyces Peyritschii Thaxter.

Fig. 16. Mature individual with two perithecia, the appendages all broken from the right side. A 12.

Fig. 17. Mature individual seen from opposite side. A 12.

Fig. 18. Antheridial appendage viewed laterally. D 4.

Fig. 19. Antheridial appendage; face view, showing three rows of antheridia. D 4.

Fig. 20. Sterile appendage. D 4.

Fig. 21. Spore. D 4.

Rhadinomyces cristatus Thaxter.

Fig. 22. Young individual, showing spinous process at base of primary appendage. D 4.

Fig. 23. Antheridial branchlet of three superposed antheridia, showing structure in optical section. $\frac{1}{12}$ 4.

DESCRIPTION OF PLATE X.

Teratomyces brevicaulis Thaxter.

Fig. 1. Mature individual with three perithecia. A 12.
Fig. 2. Single appendage. D 4.
Fig. 3. Spore. D 4.

Teratomyces mirabilis Thaxter.

Fig. 4. Mature individual with two perithecia, one immature. A 12.
Fig. 5. Single appendage from mature individual. The antheridia and lateral branches have been broken off towards its base. D 4.
Fig. 6. Young appendage bearing a row of antheridia at the left. D 4.
Fig. 7. Spore. D 2.

Teratomyces Quedianus Thaxter.

Fig. 8. Mature individual.

Teratomyces Actobii Thaxter.

Fig. 9. Mature individual. A 12.
Fig. 10. Individual not quite mature with three perithecia. The base of the trichogyne still adherent to that on the right, the two at the left seen in optical section before any spores have been discharged. A 12.
Fig. 11. Appendage with antheridia and two discharged antherozoids. D 4.
Fig. 12. Mature appendage. Two old antheridia near the base. D 4.
Figs. 13–15. Young individuals in various stages of development. D 4.
Fig. 16. Spore. D 4.
Fig. 17. Trichogyne and young perithecium seen in optical section. D 4.

Diplomyces Actobianus Thaxter.

Figs. 18, 19. Mature individuals, posterior and anterior views. A 12.
Fig. 20. Young individual. D 4.
Fig. 21. Spore. D 4.

Rhachomyces Lathrobii Thaxter.

Fig. 22. Mature individual with two perithecia. The receptacle has apparently become proliferous through the abortion of the first perithecium. The longer appendages are broken. A 12.
Fig. 23. Mature individual of typical form. A 12.

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DESCRIPTION OF PLATE XI.

Sphaleromyces occidentalis Thaxter.

Fig. 1. Mature individual. A 12.

Sphaleromyces Lathrobii Thaxter.

Figs. 2, 3. Mature individuals. A 12.

Fig. 4. Younger individual, more highly magnified. D 4.

Fig. 5. Spore. D 4.

Fig. 19. Terminal portion of appendage of a young individual, showing three antheridia and spinous process. $\frac{1}{12}$ 4.

Compsomyces verticillatus Thaxter.

Fig. 6. Mature individual: the two basal cells unusually elongate, the branch from the stalk of the perithecium somewhat abnormal. A 12.

Fig. 7. Mature individual, normal form. A 12.

Fig. 8. Mature individual developing a second perithecium at the right. A 12.

Fig. 9. Young individual, showing young perithecium and its very highly developed spirally twisted trichogyne. A 12.

Fig. 10. A young perithecium with much less highly developed trichogyne. D 12.

Fig. 11. Perithecium enlarged, showing prominences. D 4.

Fig. 12. Perithecium seen in optical section with contained ascus mass before any spore discharge has occurred. D 4.

Fig. 13. Peculiar modification of basal cell of receptacle. D 4.

Fig. 14. Portion of appendage with lateral antheridia. D 12.

Fig. 15. Two spores. D 4.

Moschomyces insignis Thaxter.

Fig. 16. Mature individual with four perithecia, two of which are shown in optical section with their spore masses, that at the left showing lateral view of ascogenic cell at its base, the other showing the round tips of the numerous asci. The cellular haustorium is shown projecting through a fragment of the soft chitinous integument of the host torn off when the fungus was removed. A 12.

Fig. 17. An ascus with eight ascospores; its stalk partly broken off. Leitz oil $\frac{1}{12}$ 4.

Fig. 18. One of the masses of coherent spores discharged from the perithecium. D 4.

Fig. 19. See above sub *Sphaleromyces Lathrobii*.

Chætomyces Pinophili Thaxter.

Figs. 20, 21. Two mature individuals. A 12.

Fig. 22. Spore. D 4.

Rhachomyces speluncalis Thaxter.

Fig. 23. Mature individual, the receptacle apparently proliferous. A 12.

Fig. 24. Mature individual typical form. A 12.

Fig. 25. Antheridium. D 4.

Moschomyces insignis Thaxter.

Fig. 26. Portion of fertile appendage with branchlet terminated by an antheridium. J 4.

DESCRIPTION OF PLATE XII.

Rhachomyces furcatus Thaxter.

Fig. 1. Spore. D 4.

Fig. 2. Mature individual: the first perithecium on the left has aborted, and the mature perithecium is borne on a proliferation of the receptacle. A 12.

Fig. 3. Mature individual, normal form. A 12.

Rhachomyces longissimus Thaxter.

Fig. 4. Mature individual. A 12.

Fig. 5. Spore.

Rhachomyces hypogæus Thaxter.

Fig. 6. Mature individual. A 12.

Rhachomyces lasiophorus Thaxter.

Figs. 7, 8. Mature individuals or Atranus, posterior and lateral views. A 12.

Fig. 9. Spore.

Figs. 10, 11. Young individuals, showing first divisions of sub-basal cell. D 4.

Rhachomyces pilosellus (Robin) Thaxter.

Figs. 12, 13. Two mature individuals. A 12.

Fig. 14. Individual with three aborted perithecia, the receptacle twice proliferous. A 12.

Fig. 15. Antheridium? Similar organs are shown in fig. 13, at the right. D 12.

Fig. 16. Spore. D 4.

Rhachomyces lasiophorus Thaxter.

Fig. 17. Mature individual on *Badister micans*. A 12.

Fig. 18. Semi-diagrammatic figure of a pair of antheridia with appendages on either side; posterior view. J 4.

Fig. 19. Position of antheridium seen sidewise, and outlined in part through the appendage which lies beside it. J 4.

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DESCRIPTION OF PLATE XIII.

Laboulbenia vulgaris Peyritsch.

Figs. 1, 2. Two mature individuals. A 12.
Fig. 3. Spore. D 4.

Laboulbenia pedicillata Thaxter.

Fig. 4. Mature individual, short form. A 12.
Fig. 5. Young individual of short form. A 12.
Fig. 6. Spore. D 4.
Fig. 7. Mature individual, elongate form. A 12.
Fig. 8. Young individual of elongate form. A 12.

Laboulbenia subterranea Thaxter.

Figs. 9, 10. Two mature individuals. A 12.
Fig. 11. Spore. D 4.

Laboulbenia truncata Thaxter.

Fig. 12. Mature individual, the tip of the appendage broken. A 12.
Fig. 13. Young individual, showing character of inner and outer appendage. A 12.
Fig. 14. Spore. D 4.

Laboulbenia perpendicularis Thaxter.

Fig. 15. Mature individual, the tip of the outer appendage broken. A 12.
Fig. 16. Inner appendage with single antheridium at left. D 12.
Fig. 17. Young individual with unbroken appendages. A 12.
Fig. 18. Spore.

Laboulbenia Nebriæ Peyritsch.

Fig. 19. Mature individual. A 12.
Fig. 20. Young individual with three antheridia on inner appendage. A 12.
Fig. 21. Inner appendage with a single antheridium at the left. A 12.

Laboulbenia Casnoniæ Thaxter.

Fig. 22. Mature individual. A 12.
Fig. 23. Spore. D 4.

Laboulbenia paupercula Thaxter.

Figs. 24, 25. Two individuals in which the inner appendage occupies opposite positions in either case. A 12.
Fig. 26. Branch of inner appendage with two antheridia. D 12.
Fig. 27. Spore. D 4.

Laboulbenia cornuta Thaxter.

Fig. 28. Mature individual, the appendages broken. A 12.
Fig. 29. Young individual. A 12.
Fig. 30. Tip of perithecium, showing appendage formed by the outgrowth of one of the lip-cells. A 12.

DESCRIPTION OF PLATE XIV.

Laboulbenia compressa Thaxter.

Fig. 1. Mature individual. A 12.
Fig. 2. Spore. D 4.
Fig. 11. Portion of branch from inner appendage with two antheridia. D 12.

Laboulbenia elegans Thaxter.

Fig. 3. Mature individual. A 12.
Fig. 4. Tip of perithecium. D 4.
Fig. 5. Branch of inner appendage with two antheridia. D 12.
Fig. 6. Spore. D 4.

Laboulbenia lepida Thaxter.

Fig. 7. Mature individual. A 12.
Fig. 8. Tip of perithecium. D 4.
Fig. 9. Branch from inner appendage with three antheridia. D 12.
Fig. 10. Spore. D 4.

Laboulbenia conferta Thaxter.

Fig. 12. Mature individual. A 12.
Fig. 13. Branch of inner appendage with two antheridia. D 12.
Fig. 14. Spore. D 4.

Laboulbenia Harpali Thaxter.

Figs. 15, 16. Two mature individuals.
Fig. 17. Branch of inner appendage with single antheridium. D 12.
Fig. 18. Spore. D 4.

Laboulbenia filifera Thaxter.

Figs. 19, 20. Mature individuals. A 12.
Fig. 21. Inner appendage with two antheridia. D 12.
Fig. 22. Spore. D 4.

Laboulbenia scelophila Thaxter.

Figs. 23, 24. Two mature individuals. A 12.
Fig. 25. Tip of branch from inner appendage with single antherozoid. D 12.
Fig. 26. Spore. D 4.

Laboulbenia recta Thaxter.

Fig. 27. Mature individual. A 12.
Fig. 28. Spore. D 4.

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DESCRIPTION OF PLATE XV.

Laboulbenia contorta Thaxter.

Figs. 1, 2. Two mature individuals. A 12.
Fig. 3. Tip of perithecium, the base of the trichogyne still adherent at the left. D 4.
Fig. 4. Portion of inner appendage with a pair of antheridia. D 12.
Fig. 5. Spore. D 4.

Laboulbenia gibberosa Thaxter.

Fig. 6. Mature individual. A 12.
Fig. 7. Portion of inner appendage with pair of antheridia. D 12.
Fig. 8. Spore. D 4.

Laboulbenia umbonata Thaxter.

Fig. 9. Mature individual. A 12.
Fig. 10. Young individual, showing antheridia and trichogyne with antherozoids *in situ.* A 12.
Fig. 11. Tip of perithecium, showing ear-like lips. D 4.
Fig. 12. Inner appendage with two antheridia. D 12.

Laboulbenia terminalis Thaxter.

Fig. 13. Mature individual. A 12.
Fig. 14. Branch of inner appendage with four antheridia. D 12.
Fig. 15. Spore. D 4.

Laboulbenia rigida Thaxter.

Figs. 16, 17. Mature individuals. A 12.

Laboulbenia polyphaga Thaxter.

Figs. 18, 19. Two mature individuals. A 12.
Fig. 20. Branch of inner appendage with six antheridia. D 12.
Fig. 21. Spore. D 4.

DESCRIPTION OF PLATE XVI.

Laboulbenia elongata Thaxter.

Figs. 1, 2. Two mature individuals. On *Platynus extensicollis.* A 12.
Fig. 3. Branch of inner appendage with antheridia. D 12.
Fig. 4. Mature individual from *Platynus cincticollis,* typical form. A 2.
Fig. 5. Spore of Fig. 4. D 4.
Fig. 6. Form on *Colpodes purpuripennis.* A 2.
Fig. 7. Spore of Fig. 6. D 4.
Fig. 8. Form on *Platynus floridanus.* A 2.
Fig. 9. Younger individual (see fig. 4) on *Platynus cincticollis.* A 2.
Fig. 10. Form on elytra of *Platynus cincticollis.* A 2.
Fig. 11. Form on *Platynus extensicollis.* A 2.
Fig. 12. Form on *Colpodes duplex.* A 2.
Fig. 13. Form on *Platynus dissectus.* A 2.
Fig. 14. Form from legs of *Platynus cincticollis.* A 2.

Laboulbenia europæa Thaxter.

Fig. 15. Mature individual from *Chlænius æneocephalus.* A 12.
Fig. 16. Spore. D 4.
Fig. 17. Part of inner appendage with antheridium. D 12.

Laboulbenia Pterostichi Thaxter.

Figs. 18, 19. Two mature individuals. A 12.
Fig. 20. Branch of inner appendage with two antheridia. D 12.
Fig. 21. Spore. D 4.

Laboulbenia parvula Thaxter.

Figs. 22, 23. Two mature individuals. A 12.
Fig. 24. Spore. D 4.

PLATE XVI

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DESCRIPTION OF PLATE XVII.

Laboulbenia zanzibarina Thaxter.

Figs. 1, 2. Two mature individuals. A 12.
Fig. 3. Branch of fertile appendage with four antheridia. D 12.

Laboulbenia inflata Thaxter.

Figs. 4–6. Three mature individuals. Fig. 6 shows aborted member of same spore pair at the left. A 12.

Laboulbenia Quedii Thaxter.

Fig. 7. Mature individual. A 12.

Laboulbenia proliferans Thaxter.

Fig. 8. Mature individual on *Eudema tropicum*. A 12.
Fig. 9. Structure at base of appendages. On *Chlænius auricollis*.
Fig. 10. Spore. D 4. Fig. 23. Groups of antheridia on fertile branch. D 12.

Laboulbenia Catoscopi Thaxter.

Fig. 11. Mature individual. A 12.
Fig. 12. Branch with antheridia. D 12.
Fig. 13. Young individual. A 12.

Laboulbenia Coptoderæ Thaxter.

Figs. 14, 15. Two mature individuals. A 12.

Laboulbenia curtipes Thaxter.

Figs. 16–18. Three mature individuals; the base of the old trichogyne persists below the apex in 16 and 18. A 12.
Fig. 19. Spore. D 4.

Laboulbenia Hageni Thaxter.

Figs. 20, 21. Two mature individuals. A 12.
Fig. 22. Young individual. A 12.

Laboulbenia cristata Thaxter (See also Plate II.)

Fig. 23. Mature individual. A 12.
Figs. 25–27. Three young individuals, showing successive stages. D 4.
Figs. 28, 29. Two more advanced conditions. A 12.

DESCRIPTION OF PLATE XVIII.

Laboulbenia arcuata Thaxter.

Figs. 1, 2. Two mature individuals. A 12.
Fig. 3. Part of fertile branch with antheridium. D 12.
Fig. 4. Spore pair. D 4.

Laboulbenia macrotheca Thaxter.

Figs. 5–7. Mature individuals. Fig. 6 the typical form. A 12.
Fig. 8. Spore. D 4.

Laboulbenia Kunkeli (Giard).

Fig. 9. Mature individual. A 2.
Fig. 10. Young individual. A 2.

Laboulbenia palmella Thaxter.

Figs. 11, 12. Two mature individuals, lateral and posterior views. A 2.
Fig. 13. Young individual with trichogyne. A 2.
Figs. 14, 15. Two young individuals. A 2.
Figs. 16–18. Anterior lateral and posterior views of tip of perithecium. D 2.
Fig. 19. Tip of branch of inner appendage bearing branch with antheridia. D 12.
Fig. 20. Spore. D 4.

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DESCRIPTION OF PLATE XIX.

Laboulbenia mexicana Thaxter.

Fig. 1. Mature individual. A 12.
Fig. 2. Branch with antheridia. D 12.
Fig. 3. Spore. D 4.

Laboulbenia melanotheca Thaxter.

Fig. 4. Mature individual. A 12.

Laboulbenia longicollis Thaxter.

Fig. 5. Mature individual. A 12.
Fig. 6. Mature individual: terminal portion, the branches all broken from the basal cells of the appendages. A 12.
Fig. 7. Branches of inner appendage with groups of antheridia. D 12.
Fig. 8. Spore.

Laboulbenia Galeritæ Thaxter.

Fig. 9. Mature individual. A 12.
Fig. 10. Lateral view of base of appendages, showing insertion of branches.
Fig. 11. Fertile branch of inner appendage with three antheridia D 12.
Fig. 12. Spore. D 4.

Laboulbenia australiensis Thaxter.

Fig. 13. Mature individual. A 12.
Fig. 14. Younger individual, showing thick perithecial wall. A 12.
Fig. 15. Antheridium. D 12.
Fig. 16. Spore. D 4.

Laboulbenia Panagœi Thaxter.

Figs. 17, 18. Two mature individuals. A 12.
Fig. 19. Two antheridia. D 12.
Fig. 20. Spore. D 4.

DESCRIPTION OF PLATE XX.

Laboulbenia Brachini Thaxter.

Fig. 1. Short form with appendages well developed. A 12.
Fig. 2. Elongate form with exceptionally simple appendages. A 12.
Figs. 3, 4. Young individuals. D 2.
Figs. 5, 6. Young individuals. D 4.
Fig. 7. Fertile branch with characteristic group of antheridia. D 12.
Fig. 8. Spore. D 4.

Laboulbenia Pachytelis Thaxter.

Fig. 9. Mature individual with abnormal septa in cells I and II. A 12.
Fig. 10. Mature individual, shorter form. A 12.
Fig. 11. Fertile appendage with two antheridia. D 12.
Fig. 12. Spore pair. D 4.

Laboulbenia Pheropsophi Thaxter.

Fig. 13. Mature individual. A 12.
Fig. 14. Antheridium. D 12.
Fig. 15. Spore pair.

Laboulbenia texana Thaxter.

Fig. 16. Mature individual. A 12.
Fig. 17. Young individual. A 12.
Fig. 18. Antheridium. D 12.

Laboulbenia decipiens Thaxter.

Fig. 19. Mature individual. A 12.
Fig. 20. Antheridium. D 12.
Fig. 21. Spore. D 4.

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DESCRIPTION OF PLATE XXI.

Laboulbenia variabilis Thaxter.

Fig. 1. Mature individual. A 12.
Fig. 2. Young individual, trichogyne with antherozoids *in situ*. D 2.
Fig. 3. Fertile branch with groups of antheridia. D 12.
Fig. 4. Spore. D 4.
Fig. 12. Tip of perithecium, the base of old trichogyne at the left. D 4.

Laboulbenia brachiata Thaxter.

Fig. 5. Mature individual. A 12.
Fig. 6. Part of fertile branch with antheridia. D 12.
Fig. 7. Spore. D 4.

Laboulbenia minima Thaxter.

Figs. 8, 9. Mature individuals. A 12.
Fig. 10. Young individual. D 4.
Fig. 11. Spore. D 4.
(Fig. 12. See *sub L. variabilis.*)

Laboulbenia Schizogenii Thaxter.

Fig. 13. Mature individual. A 12.
Fig. 14. Mature individual, small form. A 12.
Fig. 15. Young individual, anterior view, showing highly developed trichogyne with spirally coiled extremities.

Laboulbenia Clivinæ Thaxter.

Fig. 16. Mature individual, the branches of the appendage broken off. A 12.
Fig. 17. Tip of young individual, showing unbroken appendage. A 12.
Fig. 18. Spore. D 4.

Laboulbenia Morionis Thaxter.

Figs. 19, 20. Two mature individuals. A 12.
Fig. 21. Spore. D 4.
Fig. 22. Terminal portion of young individual, showing unbroken appendages. D 4.

DESCRIPTION OF PLATE XXII.

Laboulbenia luxurians Peyritsch.

Fig. 1. Mature individual. A 12.
Figs. 2–7. Young individuals, showing successive stages of development. D 2.
Fig. 8. Spore. D 10.

Laboulbenia fumosa Thaxter.

Figs. 9–17. Successive stages of development from germinating spore. D 2.
Fig. 18. Mature individual. A 12.
Fig. 19. Antheridium. D 12.
Fig. 20. Spore. D 4.

Laboulbenia confusa Thaxter.

Fig. 21. Mature individual. A 12.
Fig. 22. Young individual with unbroken appendages. A 12.

Laboulbenia compacta Thaxter.

Fig. 23. Mature individual. A 12.
Fig. 24. Young individual. D 2.
Fig. 25. Spore. D 4.

Laboulbenia Philonthi Thaxter.

Fig. 26. Mature individual. A 12.
Fig. 27. Young individual, showing divisions of basal cell of inner appendage. A 12.
Fig. 28. Young individual with peculiarly modified basal cell. D 2.
Fig. 29. Tip of perithecium with trichogyne. D 4.
Fig. 30. Spore. D 4.

Laboulbenia Gyrinidarum Thaxter.

Fig. 31. Mature individual. A 12.
Figs. 32–34. Young individuals, showing cell-structure at base of appendages. One of the characteristic branches is just beginning to develop at the right in Fig. 34. D 2.
Fig. 35. Spore. D 4.
Fig. 36. Trichogyne. D 2.
Fig. 37. Tip of perithecium enlarged.

Laboulbenia Guerinii Robin.

Fig. 38. Mature individual. A 12.

Laboulbenia Oberthuri Giard.

Fig. 39. Mature individual. A 4.

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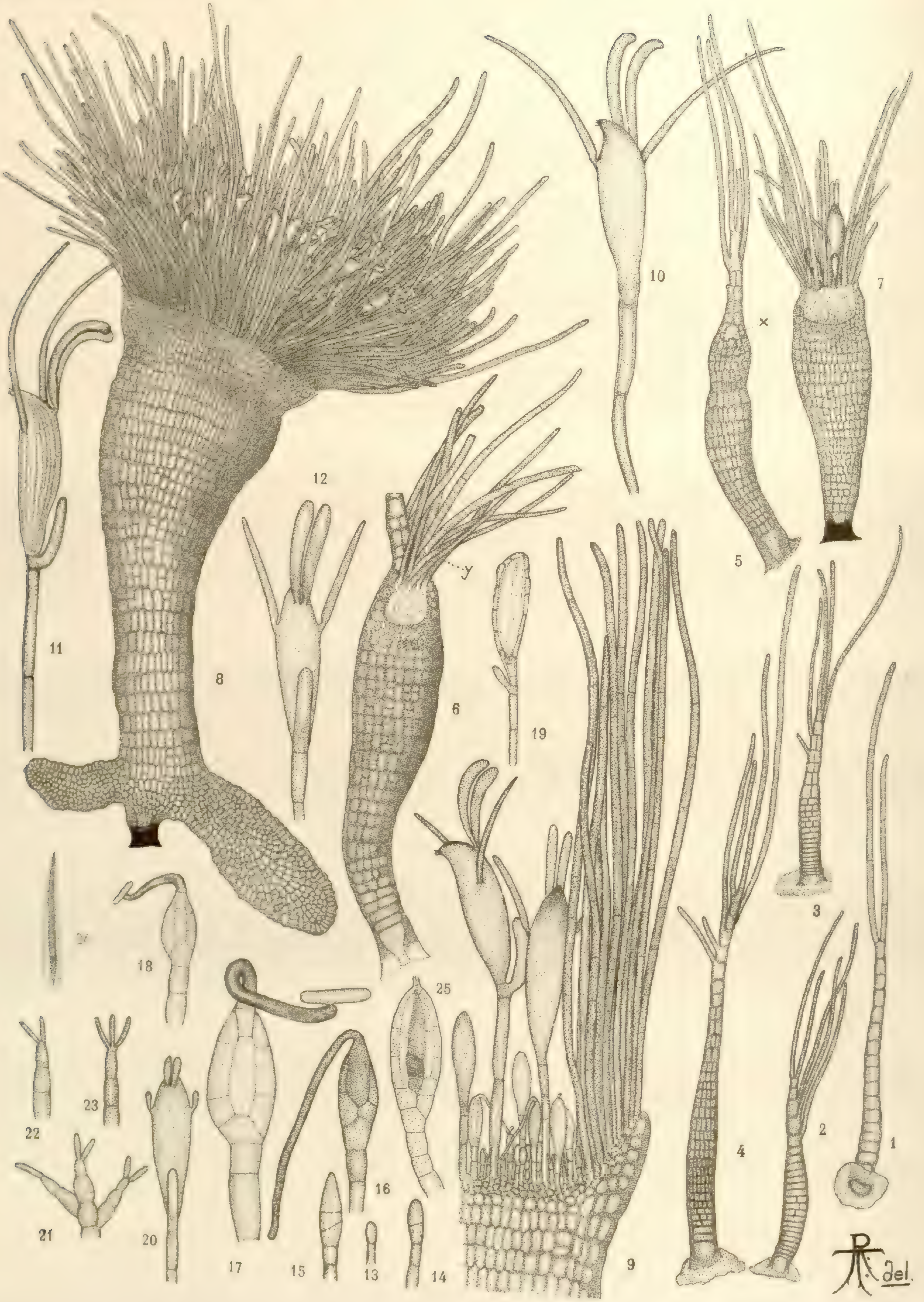

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DESCRIPTION OF PLATE XXIII.

Zodiomyces vorticellarius Thaxter.

Figs. 1–4. Young individuals in various stages of development. D 2.

Fig. 5. Young individual. A cavity is forming above the perithecigerous cells. D 2.

Fig. 6. Young individual, the upper portion of the receptacle seen in optical section. The end of the primary appendage at the left has been broken off. The secondary appendages have burst through the superficial cells at the apex of the receptacle, and the perithecia are beginning to arise from the perithecigerous cells at the base of the cup-like cavity. D 2.

Fig. 7. More mature individual, the optical section of its cup-like extremity indicated in part. The primary appendage has disappeared, and one perithecium is nearly mature. A 12.

Fig. 8. Mature individual. A 12.

Fig. 9. Section of portion of extremity showing cup-like form, the secondary appendages on the right arising from the inner surface of its rim distinct from the central fertile cells, from which arise antheridia and perithecia in various stages of development. Drawn and partly reconstructed from a microtome section. D 4.

Figs. 10–12. Anterior, lateral, and posterior views of mature perithecia. D 4.

Figs. 13–15. Very young perithecia, showing origin as terminal cell (fig. 13), and two further divisions of this cell. J 4.

Fig. 16. Young perithecium. J 4.

Fig. 17. Young perithecium with trichogyne and conjugating antherozoid. Leitz oil $\frac{1}{12}$ + 12.

Fig. 18. A similar stage. D 12.

Fig. 19. Young perithecium before development of its appendages, lateral view. D 4.

Fig. 20. Young perithecium : its appendages beginning to bud out, posterior view. D 4.

Figs. 21–23. Antheridial branches, bearing exogenous antherozoids. D 12.

Fig. 24. Spore. D 4.

Fig. 25. Young perithecium in which the ascogenic cell has divided, the trichogyne having withered and broken off. J 4.

DESCRIPTION OF PLATE XXIV.

Ceratomyces mirabilis Thaxter.

Fig. 1. Mature individual, showing spores and asci within the perithecium. A 12.

Fig. 2. Younger individual, surface view. A 12.

Fig. 3. Young individual. A 12.

Fig. 4. The same, enlarged to show the cell-structure at the base of the appendage. The young trichogyne is developing at the right. D 12.

Fig. 5. Young individual, the branched trichogyne arising between the base of the appendage and the developing perithecium. A 12.

Fig. 6. Individual younger than the last with simple trichogyne, and two conjugating antherozoids (?). A 12.

Fig. 7. The same, showing the base of the trichogyne and its cell-connections. The perithecium just beginning to develop at the left. Compare the younger condition seen in fig. 4. D 12.

Fig. 8. Growing tip of perithecium, showing cell-arrangement (**cc**) canal-cells, (**wc**) wall-cells. D 4.

Fig. 9. Ascus with ascospores. D 4.

Fig. 10. Ascospore. D 4.

Ceratomyces confusus Thaxter.

Figs. 11, 12. Two mature individuals. A 12.

Ceratomyces camptosporus Thaxter.

Fig. 13. Pair of ascospores. D 4.

Fig. 14. Mature individual. A 12.

Ceratomyces filiformis Thaxter.

Figs. 15, 16. Two mature individuals. A 12.

Fig. 17. Ascospore. D 4.

Ceratomyces rostratus Thaxter.

Fig. 18. Mature individual fully developed. A 12.

Fig. 19. Ascus with immature ascospores. D 4.

Figs. 20–23. Young individuals in various stages of development, Figs. 23, 24 showing exogenous antherozoids. A 12.

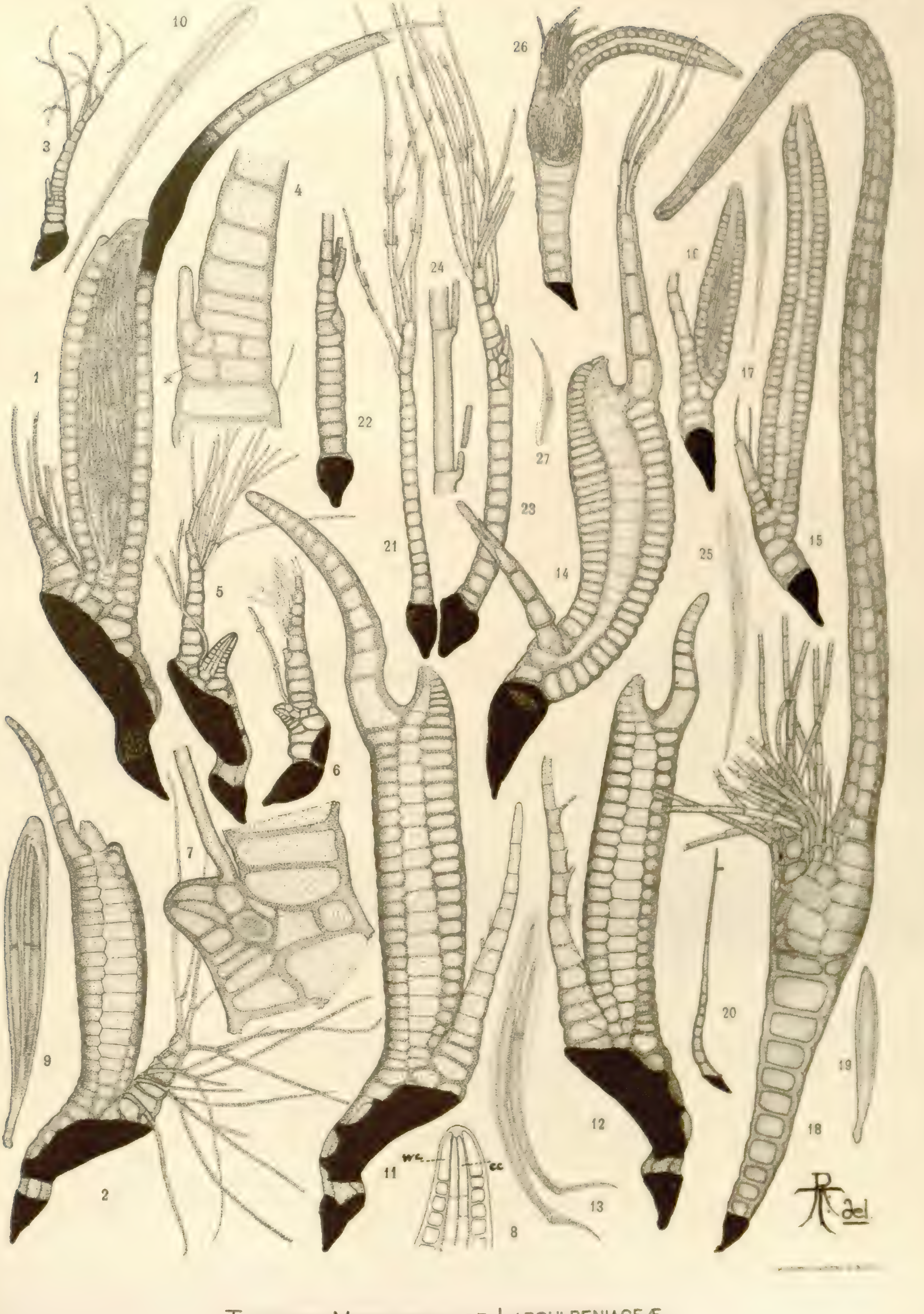
Fig. 24. Portion of fertile branch, showing antherozoids. D 12.

Fig. 25. Ascospore. D 4.

Ceratomyces rostratus var.

Fig. 26. Mature individual. A 12.

Fig. 27. Ascospore. D 4.



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DESCRIPTION OF PLATE XXV.

Ceratomyces furcatus Thaxter.

Fig. 1. Young individual with trichogyne. A 12.
Fig. 2. Mature individual, the perithecium in optical section. A 12.
Fig. 3. Mature individual, surface view. A 12.
Fig. 4. Ascospore. D 4.

Ceratomyces contortus Thaxter.

Fig. 5. Mature individual, the perithecium seen in optical section. A 12.
Fig. 6. Mature individual, surface view. A 12.
Fig. 7. Abnormal individual, producing two perithecia. A 12.
Fig. 8. Young individual with trichogyne. A 12.
Fig. 9. The same, showing cell-connections of trichogyne. D 12.
Fig. 10. Spore. D 4.

Ceratomyces humilis Thaxter.

Figs. 11–13. Mature individuals. A 12.
Fig. 14. Spore. D 4.

Ceratomyces minisculus Thaxter.

Figs. 15, 16. Mature individuals. A 12.
Fig. 17. Younger individual with old trichogyne. A 12.
Fig. 18. Spore. D 4.

Ceratomyces terrestris Thaxter.

Figs. 19–21. Mature individuals, showing various degrees of blackening in the receptacle. A 12.
Fig. 22. A mature individual, enlarged sectional view. D 4.
Fig. 23. Appendage bearing antheridia. D 12.
Fig. 24. Spore. D 4.

DESCRIPTION OF PLATE XXVI. See also Plate VI.

Chitonomyces simplex Thaxter.

Figs. 1, 2. Two mature individuals. D 2.
Fig. 3. Spore. D 4.

Chitonomyces Bidessarius Thaxter.

Figs. 4, 5. Two mature individuals. D 2.

Chitonomyces aurantiacus Thaxter.

Figs. 6, 7. Two mature individuals. D 2.

Chitonomyces borealis Thaxter.

Figs. 8, 9. Two mature individuals. D 2.

Chitonomyces hyalinus Thaxter.

Figs. 10, 11. Two mature individuals. D 2.

Chitonomyces affinis Thaxter.

Figs. 12, 13. Two mature individuals. D 2.
Fig. 14. Spore. D 4.

Chitonomyces lichanophorus Thaxter.

Fig. 15. Mature individual. D 2.
Fig. 16. Spore. D 4.

Chitonomyces rhyncostoma Thaxter.

Figs. 17, 18. Two mature individuals. D 2.

Chitonomyces melanurus Peyritsch.

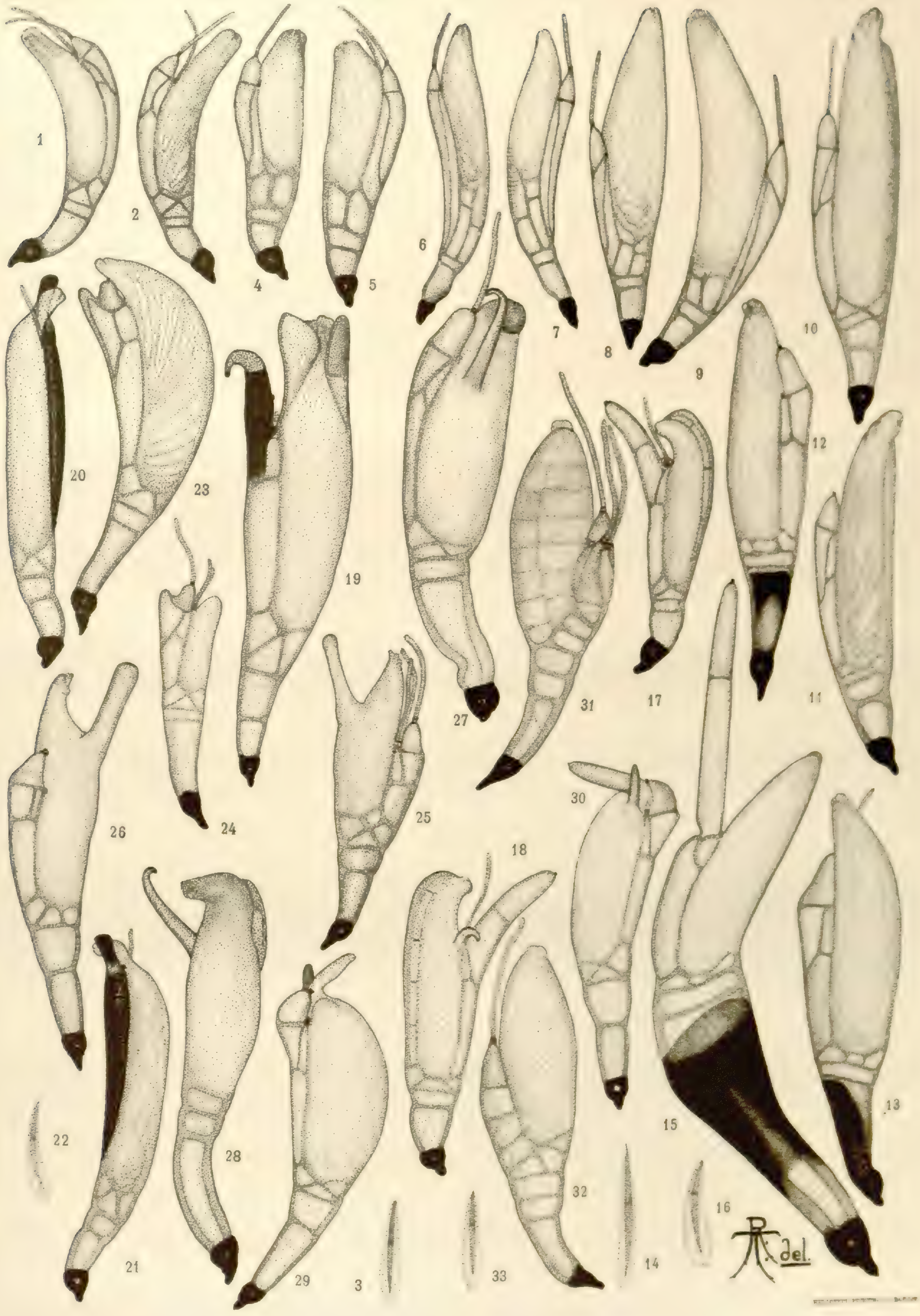
Fig. 19. Mature individual. The insertion of the appendage projects as a papilla from the inner margin of the blackened portion. D 2.

Chitonomyces marginatus Thaxter.

Figs. 20, 21. Two mature individuals. D 2.
Fig. 22. Spore. D 4.

Chitonomyces uncinatus Thaxter.

Fig. 23. Mature individual D.
Fig. 24. Young individual. D 2.



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Chitonomyces appendiculatus Thaxter.

Figs. 25, 26. Two mature individuals. D 2.

Chitonomyces uncigerus Thaxter.

Figs. 27, 28. Two mature individuals. D 2.

Chitonomyces distortus Thaxter.

Figs. 29, 30. Two mature individuals. D 2.

Hydræomyces Halipli Thaxter.

Figs. 31, 32. Two mature individuals. D 2.
Fig. 33. Spore. D 4.

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IV.

NEW OBSERVATIONS

OF

THE PLANET MERCURY.

BY

PERCIVAL LOWELL.

WITH EIGHT PLATES.

Presented May 12, 1897.

IV.

New Observations of the Planet Mercury.

By PERCIVAL LOWELL.

Presented May 12, 1897.

1. **Observations at Flagstaff.** — In the autumn of 1896 I began observations on Mercury with the 24-inch glass of this Observatory in the hope of detecting the planet's period of rotation. The condition of the air by day exceeded expectation. The telescope had scarcely shown the planet, before attention revealed markings upon its surface, — markings which proved so distinct and permanent as not only to disclose the planet's rotation-period, but to give in its fundamentals definite knowledge of the planet's self. In these observations I was assisted by Mr. D. A. Drew and Miss W. L. Leonard.

2. **Rotation Period.** — The rotation-period was synchronous with that of the orbital revolution; thus confirming what Schiaparelli, in 1889, had discovered and announced, namely, that the planet turns on its own axis once in the course of its circuit of the Sun. Though the results agreed with Schiaparelli's, their determination was entirely independent.

3. **Observations at Mexico.** — On removing to Mexico I made another series of observations, during January, February, and March of this year. There, again, the day-air proved propitious, and enabled us to confirm and extend the results obtained at Flagstaff.

4. **Method of Observation.** — Before entering upon an account of them I shall give in a word or two what is important, the method by which they were secured; since the success of the observations is due to principles which this Observatory has been investigating, the importance of which is not yet generally understood.

First. The result was not due to what most observers still consider the essentials of observation, a large aperture or keenness of vision. This I state after experience with apertures ranging from 4 to 24 inches, and after comparison of the powers of

many different eyes. At times a small aperture is better than a large one, at other times not, the relative efficiency of the glass depending upon the condition of the air. In Mexico I was able to test this very effectively by having the 6-inch clamped on to the 24-inch tube, so that it shared the advantages of the other's mechanism, and, what is as vital in such a test, it enabled the two images to be compared almost at the same instant by the same eye. I found that the performance of the 6-inch was nearly equal to that of the 24-inch; that on the average it revealed almost as many markings as the larger glass; and that when the two differed in efficiency it was apparently question of the kind of air-waves prevailing at the moment. In the moments of best seeing, the 24-inch of course distanced its competitor; but the detection of the principal markings does not demand superiority of the sort.

Secondly. Between fairly normal eyes there is practically no such thing as superior keenness of vision. After a little practice in the subject one eye proved as good as another. Not keenness of sight, but keenness of brain, distinguishes the good from the poor observer. It is with astronomical observation exactly as it is with every-day affairs. The able observer is he who perceives what any one may see.

Due neither to aperture nor eye, we come now to what it was due, to wit, to the air of the Observatory site, backed by persistence in the observer: (1) the air must be as steady[1] — not as clear — as possible; (2) the observer must study his subject. To see the markings it is necessary, for an unpractised eye, that the air should be steady enough to show the disk clear-cut. Although I have been able to detect the markings unmistakably in air such that I could not see the contours of the disk, such air would not suffice to show them to one not versed in the subject. The above criterion is sufficiently exact to begin on; later, the observer will discover that sharpness of limb and appearance of detail depend upon special and different atmospheric conditions, and do not always go together.

With regard to the second point, the best results are got by looking for the planet at times not usually thought practicable. First, the planet must be scanned by day exclusively, and as near high noon as possible. Secondly, the planet can and should be followed almost up to superior conjunction. The best time to study him is when planetary almanacs state, "Mercury invisible during the month."

In the next place, although the size of the object-glass used is largely immaterial, the power of the eyepiece is not. High powers will show nothing. I had eyepieces specially made for me; even the lowest used on large telescopes proving too high.

[1] For what constitutes steadiness I refer the reader to a preliminary monograph by Mr. Douglass, to whom is due the detection and study of its cause, in Popular Astronomy for June, 1897.

Those magnifying from 135 to 170 diameters turned out the best on the 24-inch; on the 6-inch, from 75 to 135. With 300 on the 24-inch, if the air was good, the markings still showed fairly well.

In place of low powers, diaphragming the emergent pencil — a device of Mr. Douglass — sharpens the detail. Both processes have interesting physiological bearings.

Lastly comes persistence. No air is continuously good. It has good moments and bad. The good must be patiently waited for and seized. What applies to a single sight applies *a fortiori* to acquisition of any full knowledge of the planet; and a little persistent practice will bring a great surprise, greater than the surprise of seeing it all, — the surprise that it was not all seen before.

5. **Method of Measurement.** — The mode of taking the measures also deserves a word. My measures were made with a filar micrometer, the thread being placed, not on, but near, the edges of the disk, without and within respectively. This method has great advantages over any attempt to place the thread on the limb; in fact, to place the thread on the limb accurately is impossible, first, because of the excessive irradiation produced by so doing, and secondly, because the eye is unable to see well both thread and limb at the same time.

For accuracy the filar micrometer is to be preferred to the double image micrometer. There is prevalent a curious mistake about the latter, to the effect that it eliminates irradiation. That this is not possible is easily shown by considering that contrast alone causes irradiation, and that the contrast in the case is always between the disk and the sky. The error seems to have arisen from supposing the irradiation to be due to contrast between the two disks made by the eyepiece, which of course is not the case. The only reduction of irradiation in the double image micrometer comes from the somewhat fainter images it gives, an effect which is easily produced with the filar micrometer by slightly reducing the light with an interposed glass. Thus the double image micrometer possesses on this account no advantage over the filar micrometer. On the other hand, it possesses very distinct disadvantages, for the images formed by the double eyepiece are subject to greater distortion and flare, — a distortion which renders the measures less reliable.

6. **Two Classes of Observations.** — The observations themselves consisted of two classes: (1) drawings of the planet's surface features; (2) micrometric measures of the planet's diameters and discussion of the same.

7. **Drawings.** — We will take up the drawings first. 311 drawings and 12 sketches were made of the planet's disk. Of these, 104 drawings and 5 sketches were made

at Flagstaff, and 207 drawings and 7 sketches at Mexico. In all of the drawings, markings appear depicted on the planet's surface. These markings were seen and drawn by every member of the Observatory, six observers in all, and through two different telescopes, the 24-inch and the 6-inch.

8. **Phase of Observation.** — The planet was watched from as slender a crescent as it was possible to pick up to almost a full disk. Near inferior conjunction it is difficult to find the planet, the greater angular diameter of the disk being more than offset by the phase and the fainter illumination of the surface shown. Near superior conjunction, on the other hand, the detection of the planet is much easier than one would suppose. In Mexico I observed it to within 4° of right ascension of the Sun, and only stopped there because of removing the observatory to Flagstaff. All that is necessary to render it readily visible is to screen the object-glass as much as possible from the direct rays of the Sun.

9. **Period of Rotation not Short.** — As the markings thus revealed proved: (1) distinct; (2) permanent; and as the drawings, in all 311 of which they appear, were made at intervals of time ranging from a few minutes to many months apart, the rotation period of the planet was patent, and with it the position of the axis of rotation.

They showed that the planet rotates (1) in a period synchronous with its orbital revolution; (2) round an axis substantially perpendicular to the plane of its orbit. To make this evident at a glance I have, in Plates XXX. and XXXI., reproduced two sets of three triads of drawings each, the one set by Miss Leonard, the other by me.

It will be seen that there is no perceptible shift in the positions of the markings in any of the several six triads. Yet the intervals between the drawings in Plate XXX. are: —

	h.		h.
Between 1 and 2	0.7	Between 5 and 6	2.2
" 2 " 3	3.1	" 7 " 8	3.9
" 3 " 4	20.1	" 8 " 9	0.6
" 4 " 5	1.2		

	h.
Or between the extremes of row 1, an interval of	3.8
" " " " 2, " "	3.4
" " " rows 1 and 2, an interval of	27.2
and between the extremes of row 3, " "	4.5

Similarly in Plate XXXI. we have: —

	h.		h.
Between 1 and 2	0.7	Between 5 and 6	2.0
" 2 " 3	5.0	" 6 " 7	68.1
" 3 " 4	65.3	" 7 " 8	1.4
" 4 " 5	3.4	" 8 " 9	21.5

Or taken in rows, there is between the extremes of row 1 an interval of $5^h.7$; of row 2, an interval of $5^h.4$; of row 3, an interval of $22^h.9$.

We have then in these drawings nearly all manner of intervals, from 0.6 of an hour to several days; and all without the slightest effect upon the positions, except for a slight recession from the terminator presently to be explained.

That more markings were seen at one time than at another is simply a question of the steadiness of our own air. For example, the air happened to be much steadier in Figs. 5 to 9 of Plate XXXI. than it was in Figs. 1 to 4.

The October and November drawings are among the Flagstaff ones, the January among the Mexican, and as Flagstaff time is 7 h. west of Greenwich, and Tacubaya, Mexico, $6^h.6$ west, it will be seen that these drawings were made all the way from about nine o'clock in the morning to four in the afternoon. From them it is evident that any short period of rotation is negatived; while if the positions of the markings be measured, it will be found that they all harmonize with a period synchronous with the orbital revolution.

10. **Libration.** — To prove now that such is the rotation-period: if we take all the drawings and measure in them the distance of any given marking from the terminator, we find, on reduction, this distance to be invariable, and invariability is a corollary of such synchronousness. To show this result, we must first consider an interesting detail of the planet's rotation disclosed by the markings simultaneously with that rotation itself, — the libration in longitude due to the eccentricity of the planet's orbit, since this enters as a correction into the reduction.

As the rotation of the planet must be uniform, due to the great moment of its rotary momentum, while the angular velocity of revolution of a body moving in an ellipse is not, there must be produced, in the case of isochronism of rotational and orbital periods for such an orbit, a libration of the markings in longitude.

To determine it we have: that the mean angular velocity of revolution in the ellipse is the angular velocity of a body supposed to be describing a circle in the time occupied by the planet in the ellipse. For the area of the ellipse being πab, and the period T, the areal velocity in the ellipse, which is constant, is $\frac{\pi ab}{T}$. This is the areal velocity in a circle of radius $\sqrt{ab}$ supposed described in the same time.

To find, therefore, the point on the ellipse where the radius has the value corresponding to the mean angular velocity, we must take the expression for r of the ellipse referred to its focus as a pole,

$$r = \frac{a(1 - e^2)}{1 + e \cos v},$$

and equate it to that of the circle supposed described about that focus with the length of radius $\sqrt{a\,b}$. This geometrically is the point of intersection of the two curves, since the value of r is common to both.

Consequently for the point sought

$$\sqrt{a\,b} = \frac{\sqrt{a}\,(1 - e^2)}{1 + e \cos v}.$$

Since a may be taken as unity, this is

$$\sqrt{b} = \frac{(1 - e^2)}{1 + e \cos v},$$

$$\text{or } \cos v = \frac{1 - e^2 - b^{\frac{1}{2}}}{e \, . \, b^{\frac{1}{2}}};$$

or since

$$b = \sqrt{1 - e^2}, \qquad \cos v = \frac{1 - e^2 - (1 - e^2)^{\frac{1}{4}}}{e \, . \, (1 - e^2)^{\frac{1}{4}}} = \frac{(1 - e^2)^{\frac{3}{4}} - 1}{e}.$$

In the case of Mercury, $e = .205605$; v, the true anomaly of the point of maximum libration is therefore 98° 55′.13.

But $\frac{a - r}{a\,e} = \cos u$, where u is the eccentric anomaly; and $u - e \sin u = \zeta$, where ζ is the mean anomaly; whence $v - \zeta$, which is the amount of the maximum libration, is 23° 40′ 38″.

As the period of the planet is 87.96926 days, the mean angular velocity of revolution, which in the case of Mercury is also the angular velocity of rotation, is 4°.092 a day; the angular orbital velocity at perihelion, 6°.346 a day; and the angular orbital velocity at aphelion, 2°.755 a day.

Consequently the daily gain of the angular orbital over the angular axial velocity — or the daily increase of libration east or of decrease west — at perihelion is 2°.254; similarly the loss at aphelion is 1°.337.

The time taken by the planet from perihelion, where the libration is nothing, to the point of maximum libration, is 18 days, 9.28 hours, and from this point to aphelion 25 days, 14.35 hours.

As the planet's heliocentric longitude at perihelion is now 75° 51′, the heliocentric longitude of the points of maximum libration are 174° 46′ and 336° 56′, while at 75° 51′ and 255° 51′ the libration is nothing.

Calculating the libration, together with the phase angle for February and March, 1897, — as this will be the most useful to us later on in the paper, — we get

TABLE I.

PHASE ANGLE AND ANGLE OF LIBRATION.

Greenwich Mean Noon. Date.	Phase Angle. i	Angle of Libration. ω	Greenwich Mean Noon. Date.	Phase Angle. i	Angle of Libration. ω
Feb. 4	109°.8	−23°.3	Mar. 3	55°.0	+4°.9
" 5	106.2	23.0	" 4	53.7	6.2
" 6	102.9	22.6	" 5	52.3	7.5
" 7	99.7	22.1	" 6	51.0	8.8
" 8	96.8	21.5	" 7	49.7	10.1
" 9	94.0	20.8	" 8	48.4	11.3
" 10	91.4	20.0	" 9	47.1	12.5
" 11	88.9	19.2	" 10	45.7	13.6
" 12	86.5	18.3	" 11	44.4	14.7
" 13	84.2	17.4	" 12	43.0	15.8
" 14	82.0	16.4	" 13	41.6	16.9
" 15	79.9	15.4	" 14	40.2	17.9
" 16	78.0	14.3	" 15	38.7	18.8
" 17	76.1	13.1	" 16	37.2	19.7
" 18	74.3	11.9	" 17	35.6	20.5
" 19	72.6	10.7	" 18	34.0	21.2
" 20	70.9	9.5	" 19	32.3	21.8
" 21	69.2	8.3	" 20	30.5	22.4
" 22	67.6	7.0	" 21	28.7	22.9
" 23	66.1	5.7	" 22	26.8	23.3
" 24	64.6	4.4	" 23	24.8	23.5
" 25	63.1	3.1	" 24	22.7	23.7
" 26	61.7	1.7	" 25	20.6	23.7
" 27	60.3	−0.3	" 26	18.5	23.7
" 28	59.0	+1.0	" 27	16.2	23.5
Mar. 1	57.6	2.3	" 28	13.9	23.2
" 2	56.3	3.6			

MAXIMA AND MINIMA BETWEEN SEPTEMBER, 1896, AND MARCH, 1897, WASHINGTON MEAN TIME.

In Aphelion; Libration nil .	Sept. 4	5 hours	
At Greatest Libration W. .	Sept. 29	20 "	23°.677
In Perihelion; Libration nil .	Oct. 18	5 "	
At Greatest Libration E. . .	Nov. 5	14 "	23°.677
In Aphelion; Libration nil .	Dec. 1	4 "	
At Greatest Libration W. .	Dec. 26	18 "	23°.677
In Perihelion; Libration nil .	Jan. 14	4 "	
At Greatest Libration E. . .	Feb. 1	13 "	23°.677
In Aphelion; Libration nil .	Feb. 27	3 "	
At Greatest Libration W. .	Mar. 24	17 "	23°.677

11. **Proof of Long Period of Rotation.** — On measuring the position of Testudo regio in the drawings, we find for its longitude the following results: —

TABLE II.

LONGITUDE OF TESTUDO REGIO,* 1896.

Date.	Mountain Standard Time.	Longitude Centre of Disk. Corrected for Libration.	Longitude of Centre of Testudo regio from Centre of Disk.		Resulting Longitude of Testudo regio.
			Uncorrected.	Corrected for Phase.	
	h. m.	°	°	°	°
Oct. 28	2 53	278	2	4	276
	20 31	281	5	4	276
	22 49–57	281	7	4	274
	23 46–59	281	7	4	274
Oct. 29	2 5–12	281	14	4	269
	22 12	283	12	4	271
	22 20	283	16	4	267
	22 38	283	10	4	273
	23 0	283	12	4	271
Oct. 30	4 2	284	12	4	272
	20 40–50	286	14	4	272
" 31	23 18–32	288	16	4	272
	23 41	288	14	4	274
Nov. 1	0 13	288	3	4	285†
	21 16	291	22	4	269
" 2	0 38–45	291	19	4	272
	2 40	291	17	4	274
" 4	{1 57– / 2 3}	296	32	4	264
	22 50	299	35	4	264
" 5	0 11–19	299	37	4	262
	21 39–46	301	37	4	264
	22 25–32	301	37	4	264
" 6	22 13	303	39	4	264
	22 49	303	33	4	270
" 8	{22 54– / 23 8}	308	39	4	269
Mean					270
Corrected for difference between theoretic and visible phase .					4
					274

During this period the planet revolved through 54° of its orbit.

The slight difference between these values and those published in the Astronomishe Nachrichten by the writer is due to remeasurement of the original drawings, those in the former article having been made from the published copies.

Between the first of the above set of longitudes and the last of those in the following table, the planet made one complete circuit of the Sun and 91° of another.

* Called in previous papers Argi regio.

† This drawing is evidently poor for position of terminator.

TABLE III.

LONGITUDE OF TESTUDO-REGIO, 1897.

Date.	Mexico Time (6h. 36m. west of Greenwich Mean Time).	Longitude of Centre of Disk.	Longitude of Centre of Testudo regio from Centre of Disk.		Resulting Longitude of Testudo regio.		
			Uncorrected.	Corrected for Phase. See Table VI.			
	h. m.	°	°	°	°	°	
Feb. 7	23.5						
" "	23.8	242	19	28	261	270	
" "	23.9						
" 8	0.3						
" "	21.8	246	15	24	261	270	
" "	22.4						
" 9	1.7	256	6	13	262	269	
" "	1.8						
" 11	21.8						
" "	22.1						
" "	1.5	259	5	12	264	271	
" "	2.5						272°
" 12	21.7						
" "	22.0						
" "	22.3	262	3	11	265	273	
" "	22.7						
" "	23.0						
" "	1.1						
" 13	23.6						
" 14	0.6						
" "	21.5	265	3	10	268	275	
" "	21.8						
" 15	22.4	268	–1	6	267	274	

From the above, then, we see that the period of rotation is isochronous with the period of orbital revolution.

As the chances that a mass detached from the primal nebula should rotate in the time of its orbital revolution, even under the conditions most favorable to such an event, are but one in infinity, we see that such isochronism must be an after-result to its original giving off. Now the only force capable, so far as we know, of bringing this about is tidal friction. In Mercury, then, we have before us the first planetary instance of tidal action.

12. **Axis of Rotation.** — That the axis of rotation is practically perpendicular to the plane of the orbit is shown by the fact that the movement of the markings due to libration is perpendicular to the terminator. No deviation from perpendicularity was at any time apparent.

Furthermore, the slight shift of the markings north and south, due to the heliocentric latitude of the planet at different times, was apparently discernible. If the drawings made in October and November, 1896, be compared with those made of the same part of the planet in February and March, 1897, it appears that the markings came a trifle farther north in the latter case. Now in October and November, 1896, the heliocentric latitude of the planet attained its southern limit, while in February and March, 1897, it similarly reached its northern one. Taking the planet's distance from the Earth at the time into account, the effect would be a shift of some four degrees in all. This would imply that a deviation of four degrees from perpendicularity in the axis of rotation should have been observable did it exist.

13. **Markings.** — In their characteristics the markings on the planet's surface are both unique and suggestive. The markings are: (1) unlike those on any other planet, coming nearest in appearance to those on Venus, but not resembling them to any extent; (2) long and narrow, of the nature of lines, not patches; (3) among the darkest of planetary markings; (4) although linear, not of uniform width; (5) given to appearing as a succession of dark dots, like beads on a chain; (6) darkest at points where they cross, giving rise to spots at the intersections; and (7) singularly symmetrically placed.

To prevent misconception, I may add that neither the lines nor the spots show any of that startling regularity observable in the "canals" and oases of Mars. Unlike the markings on Mars, they do not suggest artificiality.

The widest of the lines, Testudo regio, is about 4° (of longitude on the planet) wide. Most of the others are from a third to a half of this width. Such is the normal size, if one may use the expression; for Testudo regio is in many respects *sui generis*. It is worth noting that familiarity decreased the width and increased the number of the lines. (See Plates XXVIII. and XXXIV.)

The spots are not much broader than the lines, of which in many cases they seem to be but the darker portions. There have been seen nineteen of these spots at the places where lines cross. Akin to them apparently are the beads into which a line occasionally appears to break up.

In the matter of the fineness of the lines — which only in poor air look like diffuse streaks — it is interesting to note that Schiaparelli (Astronomische Nachrichten, No. 2944), with his usual ability, suspected just what has turned out to be the fact, that the markings are a mass of fine lines which he was not able to see definitely as such. His paper I read after my own observations were made.

14. **Symmetrical Arrangement.** — On plotting all the markings, 78 in number, there stood revealed a very curious symmetry in their arrangement. This symmetry showed itself first as regards the north and south portions of the illuminated disk, and then as regards the east and west sides of the same. It becomes the more noticeable on considering them in detail.

Testudo regio. — Perhaps the most conspicuous markings on the planet are two bands cutting off the two poles respectively and about 33° distant from them. Such is the appearance they present when the planet is morning star and the libration to the westward of the mean. As the libration swings east, bringing these markings inboard, the two cut-offs begin to turn toward each other, approach, and then suddenly meet to form one long marking running north and south. To an observer noting this change of intention for the first time, the effect is striking. For beyond the band lies white disk, all the way up and down. But unexpected and startling as the effect is, the fact of it becomes no less so when calculation shows this band to lie on the meridian of mean libration.

The band I have called Testudo regio. It is the most important marking on the eastern side of the planet, — the orientation is to one standing on the planet with his face to the south, — and is, as I have said, four degrees of Mercurian longitude broad, that is, about 120 of our miles. Once in a moment of exceptional seeing I had the good fortune to see it perfectly contoured; that is, the edges were sharply differentiated from their surroundings.

Next in salience are lines running across the disk along what the position of the axis shows to be parallels of latitude. One of these lies almost upon the equator, while others cross at diverse distances north and south of it. The list of those so far detected is as follows: —

About 41° south.
29° "
17° "
6° "
1° north.
9° "
20° "

Besides these are others not definitely enough recognized to be mapped.

Next comes a set of lines running apparently on the meridians; of which the three most salient ones are situated in about longitude 335°, 0°, and 28° respectively. They run, so far as I have been able to determine, due north and south, and practically stretch from pole to pole.

Crossing these two sets at angles of about 38° are two other sets of transverse ones, in a general way 30° apart and in nearly equal numbers on opposite sides of the zero meridian, some six or seven running northwest and southeast across the disk, and about the same number running northeast and southwest.

It might seem to be supererogatory to point out that this symmetry is on the planet, not elsewhere, as the lines that cause the symmetry turn with the planet.

Before considering what this singular arrangement may betoken, certain other features of the disk are to be noted.

15. **No Clouds.**— The markings always show when their particular part of the planet is turned toward us, unless our own atmosphere at the moment be too bad. This invariable visibility of the markings is the first point to be remarked. For it shows that nothing near the surface of Mercury hides that surface from view. In other words, no clouds or mists or fog float between us and it. The surface lies bare to our gaze.

16. **Surface Colorless.**— Next, that surface is colorless, the markings standing out in dark relief against the otherwise uniform pale white. Unlike Mars, with his beautiful opal-like tints, — rose-ochre and blue-green, — unlike the hues of the Earth seen from afar, — unlike even Venus, with her straw-colored veil, — Mercury shows a face as ashen as the Moon, a chiaroscuro in black and white.

17. **No Change.** — No change ever sweeps over this face. The markings look at one time, apparently, just as they do at another.

18. **No Polar Caps.** — There is no sign of white in the neighborhood of the poles.

19. **Atmosphere.** — None of the effects which would follow upon the presence of an atmosphere are discernible; nor were any evident during the observations at this Observatory when the planet crossed the Sun's face in November, 1894. If there be an atmosphere, it is thin.

20. **Surface Physical Characteristics.** — From these observations stand disclosed the following physical features of the planet's surface; (1) that nothing veils it in the way of clouds; (2) that it holds no appreciable atmospheric envelope: (3) that it has no polar snows; (4) that it contains no bodies of water; (5) that it supports no vegetation; (6) that no change takes place upon it; and that, in short, it is a dead world. The first point is proved by the continuous visibility of the markings; the second, negatively by what I have stated above, and positively by the albedo of the disk and the loss on the terminator shown by micrometer measures of the diameters; the third, by the absence of white at the poles; the fourth and fifth, by the entire

absence of both change and color anywhere; and the sixth, by the immutability of the whole.

All these characteristics are just what the rotation period and the kinetic theory of gases would lead us to infer as probable upon a globe of Mercury's size rotating as he does. Observation thus corroborates inference.

Two further points are worth noting, the one the brightness along the limb, the other the shadings at the cusps.

21. **Brightness along Limb.** — From some time before to some time after the moment of dichotomy the limb is noticeably brighter than any other part of the disk. The brilliancy is almost invariably confined to a bright line or a narrow lune; and what is curious, it is not always in the centre of the limb, but on occasions is conspicuous along its southwestern edge while being absent from its middle. I have noted this peculiar position of the illumination at recurrent elongations, although chronicling it but once. My written notes are as follows: —

Sept. 2, '96, limb brightest part of planet;
14, limb bright all-round like Moon.

At another elongation: —

Oct. 16, '96, limb much brighter than rest of disk;
18, limb, especially S, the brightest part of the disk;
20, planet's disk brightest a little in from limb N.

And at yet another: —

Feb. 6, '97, limb brighter than rest of planet;
7, bright along limb, brightness in a line along limb;
9, disk brightest along central portion of limb;
23, very bright along limb;
Mar. 2, bright along limb.

22. **Shadings at the Cusps.** — At one or both of the cusps is frequently visible a shading, especially when the phase is a crescent. This is not, seemingly, a part of the failure to see the cusps, although it may be due to such cause, but apparently is produced by a shading within their contour. The effect may last until the planet is fairly gibbous. See Figs. 1, 2, 3, 4, 5, 6, 8, 9, Plate XXX.; Figs. 1, 2, 3, Plate XXXI.; and Figs. 1, 2, 3, 4, Plate XXXII.

23. **Albedo.** — The look of the planet shows its albedo to be low. For while the markings are more contrasted with their surroundings than is the case with Venus, — with which body it is best to compare Mercury, — the general reflective power of the planet's surface is much less. This appeared *passim* in the course of the observa-

tions. At the time the observations began the planet was between superior conjunction and eastern elongation, and lay at the time very conveniently placed for comparison with Venus, the two planets being near each other, Mercury lying at first at a somewhat greater angular distance from the Sun, and then at a slightly less, Venus passing out and Mercury in on September 24. The difference in the albedo or intrinsic brightness of the surface of the two bodies was most marked. My initial note on Mercury, on August 21, reads: "Mercury, — strikingly not so bright in albedo as Venus; just looked at on a brighter sky, too." At this time Mercury was nearer the Sun in the proportion of 100 to 165, and therefore his surface was 2.73 times more brilliantly illuminated than hers. But the relative lustre of the two was even more disproportionate the other way. This relative appearance continued to be presented on every occasion, only with ever increasing contrast. For as Mercury's phase increased, his surface lost visibly in lustre; that is, quite apart from the loss in area as a whole, what illuminated surface remained showed much less bright, square unit for square unit, than it had when the disk was nearer the full. A similar loss of albedo with increase of phase is shown by our Moon.

In consequence of this loss with increase of phase, the disproportion between Venus and Mercury is not quite so great as appeared on August 21, inasmuch as Venus at that time was the nearer to the full.

On the other hand, I have compared Mercury with the Moon and found his surface the brighter of the two in about the proportion that his greater proximity to the Sun would cause. He thus shows as an airless body should.

24. **Explanation of the Map.** — From the markings detected at Flagstaff and in Mexico is constructed the map of the planet in Plate XXVII. The face the planet shows us suggested the projection to be used, — parallel projection for the latitudes and an equidistant one for the longitudes. For since the axis of rotation is substantially perpendicular to the Earth's orbit, the latitudes are seen forever foreshortened in parallel projection, while the longitudes are all of them at one time or another seen as they are.

To either side of the hemisphere of mean libration I have added wings on the same projection for such further longitudes as the libration reveals.

The longitude of the centre of the disk when at its mean libration is taken as the zero meridian.

25. **Signification of the Symmetry of the Markings.** — From all of the foregoing we see that Mercury is a dead body, like our own Moon. Was it always so or not is the next question. With regard to this, the curious symmetry observed in the

position of the markings has something to say. And in this connection it is distinctly to be noted that, though in a general way symmetric, the two sides are by no means the same. The markings are suggestively bilateral without being like. Now when we take three facts into account: (1) the symmetry north and south; (2) the symmetry east and west; (3) the relation of Testudo regio to the line of mean libration: — we have pretty clearly hinted that the planet has turned the same face to the Sun from before such time as the markings were made; and that the markings are due to some cause which has since operated upon this face to the exclusion of the other. This cause can be none other than the heat received from the Sun. The continuous hiding of one hemisphere from the Sun's rays would cause a greater contraction in it than in the other in the days when the cooling was going on, and this unequal cooling of one side would result in cracks, — cracks which we now see stereotyped in the markings. This explanation, which has been suggested to me, seems the most probable one to adopt. Besides accounting for the general symmetry of the markings, it explains in addition why they should be lines rather than patches.

26. **Genesis of Isochronism.** — We perceive, also, that this theory of their genesis agrees with what we should expect to find. For the present practically airless condition of Mercury must have resulted very early in its career as a body separate from the primal nebula. In consequence there can since then have been neither air nor water upon the planet, — none of the wherewith to cause tides to break its rotation. The slowing up must therefore have been brought about by substantial tides, — tides, that is, of the whole body, — and therefore have taken place before the planet had solidified. Consequently when the planet was solidifying it was already presenting the same face in perpetuity to the Sun, from which cracking would inevitably result. We conclude, then, that Mercury is not only a dead world now, but that it has never been anything else.

27. **Surface Visible.** — From the rotation period and the libration it appears that we see at one time or another five eighths of the planet's surface, and that the other three eighths remain forever hidden from view because forever unilluminated.

28. **Measures of the Planet's Diameters.** — Between the 2d of September, 1896, and the end of March, 1897, I made 109 sets of measures of the planet's diameters. These were taken through the phase axis and the diameter perpendicular to it. Each set consisted of three double diameters. The sets were nearly all complete. The mean of each set was then expressed in seconds of arc, corrected as in the tables, especially for irradiation, reduced to distance unity, and tabulated. The results for the polar measures are given in Table IV.; those for the equatorial in Table V.

As the markings showed that the planet's polar axis was substantially perpendicular to the plane of its orbit, these phase polar and phase equatorial diameters practically coincided with the true ones.

29. **Correction for Threads.** — The correction for the threads, owing to the way the diameters were taken, is a very small quantity and is massed with that for the spurious disk. The correction for the micrometer thread and the spurious disk is taken at 0″.20 for the old micrometer; at 0″.10 for the new micrometer in January; and at 0″.07 for the new micrometer in February and March.

30. **Correction for Irradiation.** — A word upon the correction for irradiation is necessary. In all planetary measures the correction for irradiation is of fundamental importance, in spite of which it is usually either not applied at all, or applied *en bloc* to the final result. Determinations are obtained ignoring it, which in consequence are quite worthless. To show the magnitude of the error thus committed, I may take the expression for the polar compression say of Mars $\frac{a-b}{a}$, with a and b nearly equal. If the correction for irradiation, as frequently happens in consequence of phase, be a third as great again on b as on a, while on either it is two or three times as great as the difference between them, it is evident that by ignoring it the value obtained for the ellipticity is vitiated nearly one hundred per cent.

The correction for irradiation I got from intercomparison of measures made upon a painted disk, upon Mars, Venus, and Mercury, and from estimates made upon the old moon in the new moon's arms, taking in all these cases relative albedos, eyepieces, object-glass, and sky illumination into account. That the resulting correction is not far from the truth seems to be indicated by the fact that the diameters thus got for Venus and Mars agree closely with the best previous determinations; the polar diameter of Venus, at distance unity, coming out 16″.96, and that of Mars 9″.32.

For the polar diameter, the correction for the irradiation is taken at 0″.07 at the beginning of the time, and thence graded to 0″.20 at the end, because of the constantly increasing illumination at the cusps.

TABLE IV.

POLAR DIAMETERS OF MERCURY, 1897.

Date.	G. M. T. Hour.	Uncor.	Cor. for Mic. Th. and for Spu. Disk.	Cor. for Irr.	Reduced to Dist. Unity.
Jan. 6	11.3	6.97	6.87	6.80	6.64
Feb. 9	5.4	8.06	7.99	7.92	6.87
" 13	6.2	8.07	8.00	7.93	7.41
" 15*	5.8	7.61	7.41	7.34	7.10
" 18	6.9	6.26	6.19		
" 19	6.3	6.53	6.46		
" 20	5.6	6.39	6.32		
" 21	5.7	6.35	6.28		
" 22	4.1	6.84	6.77	6.68	7.15
" "	5.2	6.04	5.97		
" 23	5.3	6.23	6.16		
" 24	4.2	6.41	6.34	6.23	6.84
" "	5.2	5.78	5.71		
" 25*	3.7	6.56	6.36	6.25	6.94
" 26	4.3	6.07	6.00	5.88	6.61
" "	5.4	6.14	6.07	5.95	6.69
" 28	3.9	6.53	6.46	6.34	7.29
" "	4.4	6.46	6.39	6.27	7.21
" "	4.6	6.64	6.57	6.45	7.42
Mar. 1	3.1	6.21	6.14	6.02	6.99
" "	3.3	6.18	6.11	5.99	6.95
" "	4.0	6.41	6.34	6.22	7.22
" "	4.4	6.40	6.33	6.21	7.21
" 2*	3.4	6.59	6.39	6.27	7.35
" "	3.9	6.54	6.34	6.22	7.30
" "	4.3	6.41	6.21	6.09	7.15
" 3*	3.7	6.81	6.61	6.49	7.69
" "	4.0	6.47	6.27	6.15	7.28
" "	4.7	6.14	5.94	5.82	6.90
" 4	3.7	6.14	6.07	5.94	7.10
" "	4.6	6.12	6.05	5.92	7.08
" 5	3.3	5.99	5.92	5.79	6.98
" 6	4.7	6.22	6.15	6.02	7.33
" "	5.2	6.17	6.10	5.97	7.27
" 8	3.4	5.80	5.73	5.58	6.90
" "	4.6	6.08	6.01	5.86	7.25
" 9	3.4	6.03	5.96	5.81	7.24
" "	3.8	6.05	5.98	5.83	7.27
" 10	2.9	5.84	5.77	5.62	7.06
" "	3.8	6.09	6.02	5.87	7.37
" "	4.0	6.00	5.93	5.78	7.26
" 11	3.1	6.03	5.96	5.80	7.34
" 12	3.5	5.97	5.90	5.74	7.31
" 15	3.9	5.70	5.63	5.46	7.08
" "	3.9	5.79	5.72	5.55	7.20
" "	4.4	5.77	5.70	5.53	7.17
" 17	3.2	5.63	5.56	5.39	7.07
" "	3.8	5.58	5.51	5.34	7.00
" 19	4.2	6.02	5.95	5.76	7.62
" 20	4.6	6.04	5.97	5.78	7.68
" 21	3.9	5.81	5.74	5.54	7.39
" 23	4.1	5.81	5.74	5.54	7.43
" 26	4.2	5.76	5.69	5.49	7.40

* Measures on these dates made with old micrometer; all others with new one.

TABLE V.

EQUATORIAL DIAMETERS OF MERCURY, 1897.

Date.	G. M. T. Hour.	Uncor. Irr.	Cor. Mic. Th.	Cor. Irr.	Reduced to Dist. Unity.
		"	"	"	"
Jan. 6	11.3	4.06	3.96	3.83	3.74
Feb. 9	7.0	3.60	3.53	3.40	2.95
" 13	6.7	4.28	4.21	4.08	3.81
" 19	6.8	4.13	4.06	3.93	4.04
" 20	6.2	4.12	4.05	3.92	4.09
" 21	6.0	4.36	4.29	4.16	4.40
" 22	4.7	4.11	4.04	3.91	4.19
" 23	6.1	4.22	4.15	4.02	4.37
" 24	4.7	4.04	3.97	3.84	4.22
" 28	4.2	4.11	4.04	3.91	4.49
Mar. 1	3.6	4.01	3.94	3.81	4.42
" 4	4.0	4.10	4.03	3.90	4.66
" "	4.2	4.20	4.13	4.00	4.78
" 5	3.5	4.21	4.14	4.01	4.84
" 6	5.5	4.34	4.27	4.14	5.04
" 8	3.7	4.41	4.34	4.21	5.21
" "	4.4	4.50	4.43	4.30	5.32
" 9	3.7	4.35	4.28	4.15	5.17
" "	4.6	4.57	4.50	4.37	5.45
" 10	3.1	4.32	4.25	4.12	5.17
" "	3.4	4.43	4.36	4.23	5.31
" 11	3.6	4.41	4.34	4.21	5.33
" 17	3.5	4.43	4.36	4.23	5.55
" 19	4.5	4.98	4.91	4.78	6.33
" 20	4.8	5.05	4.98	4.85	6.44
" 23	4.4	4.99	4.92	4.79	6.43
" "	4.9	5.07	5.00	4.87	6.53
" 26	4.6	5.32	5.25	5.12	6.90

The correction for irradiation was taken at 0″.13 throughout.

31. **Measures of Drawings.** — Besides tabulating the measures, I have measured the phases of the drawings and tabulated them in Table VI., the phase entered for any day being the mean of the values for that day. The ratio of the visible polar and equatorial diameters is given first; then the phase angle to which this corresponds; and, lastly, the difference between this phase angle and the theoretic phase at the time. Besides these for comparison are placed the phase ratios, angles, and difference got from the measures corrected for the micrometer threads, but not corrected for irradiation; in other words, such as they appeared to the eye.

TABLE VI.

1897. Date. G. M. N.		Phase Angle Theoretic.	Drawings : Ratio Equat. to Polar Diameters.	Phase Angle of Drawings.	Diff. between Theoretic and Drawn Phase.	Mic. Meas. Rats. Equat. to Polar Diams. both cor. for Threads only, and Polars graded from 6″.98 to 7″.62.	Phase Angle of Micrometric Measures.	Diff. between Theoretic and Measured Phase.	Remarks.
Jan.	4	73°.3	.553	83°.9	10°.6				
"	5	76.5	.499	90.1	13.6				
"	6	81.3	.482	92.1	10.8	.550	84°.2	2°.9	
"	7	86.4	.452	95.5	9.1				
"	8	91.3	.423	98.9	7.6				
"	9	96.7	.404	101.1	4.4				
"	11	108.4	.332	109.6	1.2				
"	12	114.0	.340	108.6	−5.4				
Feb.	5	105.0	.342	108.4	3.4				
"	6	101.9	.348	107.6	5.7				
"	7	98.8	.372	104.8	6.0				
"	8	96.0	.368	105.3	9.3				
"	9	93.3	.396	102.0	8.7	.439	94.4	1.1	
"	12	85.8	.472	93.2	7.4				
"	13	83.6	.492	90.9	7.3	.560	83.1	−0.5	
"	14	81.5	.507	89.2	7.7				
"	15	79.4	.529	86.7	7.3				
"	16	77.4	.547	84.6	7.2				
"	17	75.6	.534	86.1	10.5				
"	18	73.8	.549	84.3	10.5				
"	19	72.1	.542	85.2	13.1	.588	79.8	7.7	Testudo regio at edge, 1 drawing.
"	20	70.5	.538	85.7	15.2	.593	79.3	8.8	
"	21	68.7	.545	84.8	16.1	.636	74.2	5.5	
"	22	67.3	.550	84.2	16.9	.606	77.8	10.5	" "
"	23	65.7	.574	81.5	(15°.2) 15.8	.629	75.1	9.2 (9°.9)	" "
"	24	64.3	.617	76.5	12.2	.609	77.4	13.1	
"	25	63.0	.612	77.1	14.1				" "
"	26	61.5	.597	78.8	17.3				
"	28	58.8	.634	74.5	15.7	.645	73.1	14.3	" "
Mar.	1	57.4	.660	71.3	13.9	.634	74.5	17.1	
"	2	56.1	.672	69.8	13.7				Partly gone.
"	3	54.8	.702	66.2	11.4				Wholly gone.
"	4	53.5	.722	63.7	10.2	.661	71.2	17.7	
"	4	53.5	.722			.677	69.3	15.8	
"	5	52.2	.770	56.1	3.9	.683	68.5	16.3	
"	6	50.8	.767	57.7	6.9	.709	65.3	14.5	
"	8	48.2	.792	54.2	6.	.729	62.7	14.5	
"	8	48.2	.792	54.2	6.	.744	60.8	12.6	
"	9	46.9	.810	51.7	4.8	.722	63.6	16.7	
"	9	46.9	.810	51.7	(4°.2) 4.8	.759	58.8	11.9 (15°.8)	
"	10	45.6	.823	49.8	4.2	.720	63.8	18.2	
"	10	45.6	.823	49.8	4.2	.739	61.4	15.8	
"	11	44.2	.834	48.1	3.9	.739	61.4	17.2	
"	12	42.7	.850	45.6	2.9				
"	14	39.7	.853	45.1	5.4				
"	15	38.2	.867	42.9	4.7				

1897. Date. G. M. N.	Phase Angle Theoretic.	Drawings: Ratio Equat. to Polar Diameters.	Phase Angle of Drawings.		Diff. between Theoretic and Drawn Phase.	Mic. Meas. Ratio Equat. to Polar Diams. both cor. for Threads only, and Polars graded from 6″.98 to 7″.69.	Phase Angle of Micrometric Measures.	Diff. between Theoretic and Measured Phase.		Remarks.
	°		°		°		°	°		
Mar. 17	35.3	.880	40.5		5.2	.757	59.1	23.8		
" 18	33.6	.915	33.9		0.3					
" 19	31.9	.900	36.9		5.	.858	44.2	12.3		
" 20	30.1	.930	30.7		0.6	.872	41.9	11.8		
" 21	28.2	.912	34.5	4.2°	6.3				15.8°	
" 22	26.4	.920	32.9		6.5					
" 23	24.6	.950	25.8		1.2	.864	43.3	18.7		
" 23	24.6	.950	25.8		1.2	.878	40.9	16.3		
" 26	18.3	.967	20.9		2.6	.921	32.7	14.4		
" 27	15.9	.965	21.6	4.4	5.7					
" 28	13.6	.973	18.9		5.3					

Even before discussing them it is evident at a glance that the drawings are as accurate as the measures. This is a point worth noting, because of a very general but quite unfounded prejudice towards pinning one's faith to measures. As a matter of fact both measures and drawings depend upon eye estimates, and which of the two is the more trustworthy is a question of the kind of estimate involved.

32. **Previously received Diameters too Small.** — The measures to be discussed first are the micrometric ones of the polar diameters; and the first result indicated by them is that the hitherto received value of the planet's diameter is apparently much too small. Instead of giving the value 6″.68 for the diameter at distance unity, the measures make the polar diameter at that distance, after all correction had been taken into account, 7″.54.

33. **Explanation of it.** — Not only do the measures state this definitely, but they produce internal evidence to account for the smallness of previous determinations. They do this in what may seem an unexpected manner.

Measures of Mercury have to be made, either (1) upon the planet in transit, or (2) upon the planet as affected by phase, inasmuch as we cannot see through the Sun.

Now the present measures show that in both these cases the planet necessarily appears smaller than it is: in the first case, through irradiation; in the second, through relative invisibility of the cusps. With regard to the irradiation, the consequent loss of apparent size at transit speaks for itself; the present measures have, however, something to say about its amount, as we shall see presently. With regard to the loss of size through relative invisibility of the cusps, the measures established

three points: (1) in poor seeing the measures decreased; (2) when the cusps were estimated, however slightly, the measures dwindled till they were actually smaller than previous determinations; (3) as the planet passed from quadrature toward conjunction, the measures of the polar diameters (reduced to distance unity) steadily increased. The first of these facts was testified to, *passim*. As an instance we may take the observations of March 2d and 3d.

TABLE VII.

Date.	G. M. T. Hour.	Uncor. Irr.	Corrected and Reduced to Distance Unity.	
		″	″	
Mar. 2	3.4	6.59	7.28	Seeing growing poorer.
" "	3.9	6.54	7.23	
" "	4.3	6.41	7.08	
Mar. 3	3.7	6.81	7.62	Seeing growing poorer.
" "	4.0	6.47	7.21	
" "	4.7	6.14	6.83	

We see how the decrease in the measures kept step with the decrease in the definition.

The second point is interesting because apparently conclusive. For in the day air of almost all observatories where previous determinations have been made, estimation to a greater or less extent is inevitable. So that in this case the conditions at Flagstaff were assimilated to those of other places. This is shown in Table VIII.

TABLE VIII.

Date.	G. M. T. Hour.	Uncor.	Cor. for Irr. Mic. Th. and Spu. Disk.	Reduced to Dist. Unity.	Uncor. reduced to Dist. Unity.
		″	″	″	″
Feb. 18	6.9	6.26	6.11	6.20	6.28
" 19	6.3	6.53	6.37	6.55	6.65
" 20	5.6	6.39	6.23	6.50	6.70
" 21	5.7	6.35	6.19	6.55	6.64
" 22	5.2	6.04	5.89	6.31	6.40
" 23	5.3	6.23	6.05	6.57	6.69
" 24	5.2	5.78	5.60	6.15	6.28
				6.40	6.52

The third point we see at once on taking the means of the polars for successive dates and arranging them in a table as follows.

TABLE IX.

MEANS OF POLAR DIAMETERS.

Date.	Reduced to Dist. Unity. Cor. only for Threads and Spurious Disk.	Reduced to Dist. Unity. Cor. for Irr.
	"	"
Feb. 9	6.93	6.87
Jan. 6 } Feb. 13–25 }	7.10	7.01
Feb. 25–Mar. 1	7.20	7.06
Mar. 2–10	7.35	7.18
" 11–20	7.52	7.30
" 21–26	7.67	7.41

34. **Value of Polar Diameter.** — Taking now Table IX. and extending it to its proportionate result at conjunction, we have for the polar diameter the following values: —

Uncorrected for irradiation, 7″.80.
Corrected for irradiation, 7″.54.

These measures give for the planet a polar diameter of about 3,400 miles.

35. **Dichotomy.** — We now come to another explanation the measures afford upon quite a different subject, namely, the retardation of the apparent time of dichotomy. During the period covered by the observations dichotomy occurred four times (Washington mean time); namely, on

1896, September 11, 0 h. about.
" October 25, " "
1897, January 5, 2 h.
" February 13, 14 h.

while dichotomy should have occurred on

1896, September 16, 20 h.
" October 22, 8 h.
1897, January 8, 1 h.
" February 10, 12 h.

The discordance between the calculated and observed times of the phenomenon was therefore: —

	5 days 20 h.
	2 days 16 h.
	2 days 23 h.
	3 days 2 h.
and the mean: —	3 days 4 h.

To translate these times of retardation into phase angles of loss, we may have recourse (1) to the calculated phase; (2) to the phase loss of the drawings at the time. Thus obtained, the phase loss at these times respectively was: —

(1) °	Wt.	(2) °	Wt.
11.0	1	11	1
18.7	1	13	2
13.6	4	14	4
7.6	3	7	3

and the means, (1) 11°.9 (2) 11.°4

From the measures of the drawings we find further that the observed phase loss at the times of theoretic dichotomy at these four elongations was respectively: —

	°	Wt.
September 16,	9.6	1
October 22,	13.7	1
January 8,	8.1	1
February 10,	8.0	1

Giving a mean of 9°.9.

36. **Explanation of it.** — The cause of the discordance between the apparent and theoretic times of dichotomy has not hitherto been satisfactorily explained. Discussion of Table IX. will, I think, betray its cause.

If the centre of the terminator and its extremities lost equally in phase through inability in the eye to detect the oblique illumination out to its theoretic limit, no discordance between the observed and calculated times of dichotomy could, in the case of a sphere, ensue; in the case of an ellipsoid, there would be a difference between the observed and the calculated times of dichotomy, but as observed dichotomy would be just as likely, in the long run, to occur on the one side as on the other, the discrepancy would in the mean be zero, whereas the discordance observed is always

on the same side of its theoretic value, being behind time when the phase is increasing, and ahead of it when it is decreasing. This proves, then, that the discrepancy is due to a relative visibility or non-visibility of the cusps, as compared with the centre of the terminator.

Now, if the illumination at the cusps was relatively less than that at the terminator, dichotomy would occur before its predicted time, as a geometrical consideration will show. We are therefore left with the alternative; namely, that retardation of dichotomy is due to relative prolongation of the cusps. And this can easily be shown geometrically to be the fact, as in the following diagram, where *A B*, Fig. 1, and *B C*, Figs. 2 and 3, represent the loss at their respective phases.

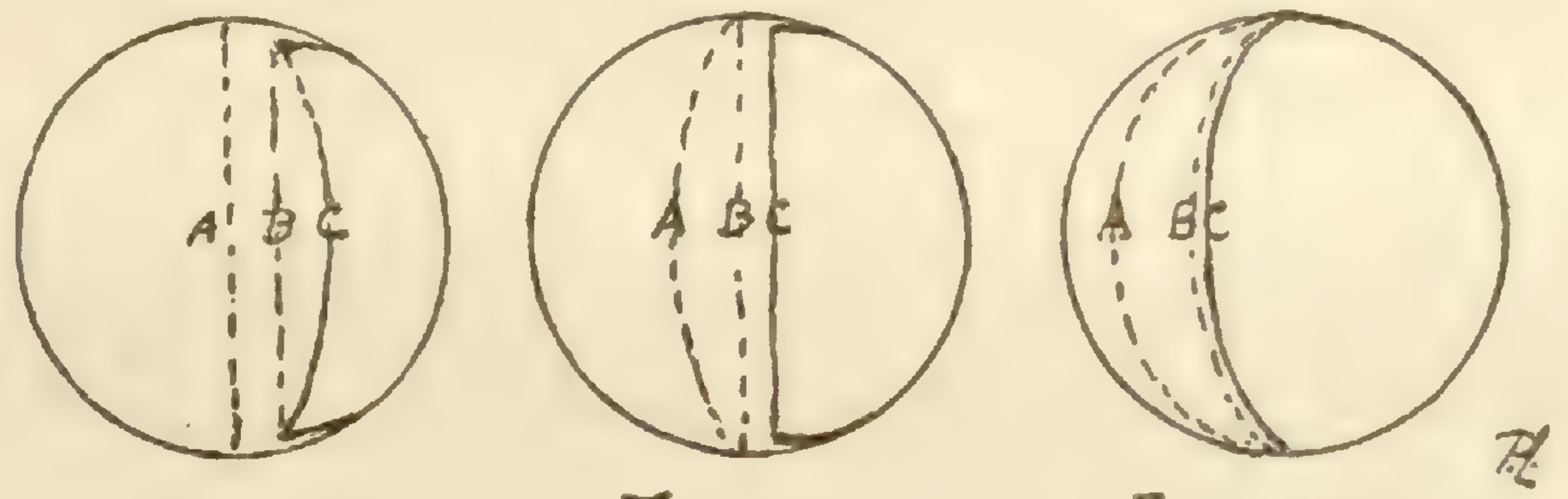


Fig. I. Fig. II. Fig. III.

37. **Loss at the Cusps.** — On the other hand, it is evident that there is some loss of visibility at the cusps. This is evident, both theoretically — otherwise there would be no loss at the centre of the terminator, since the cusps cannot be infinitely brighter than the centre — and practically, as it is witnessed to by the measures of the polar diameter, which (Table IX.) show an increase steadily from the time of dichotomy to the time of conjunction.

38. **Cusp Loss varies with Phase.** — The relative loss at the cusps is not constant. It varies with the phase. This is shown by the following table.

TABLE X.

RATIO OF EQUATORIAL TO POLAR DIAMETER, FROM DRAWINGS AND DIFFERENCE OF OBSERVED AND THEORETIC PHASE.

G. M. T. Date.	Ratio Equat. to Polar Diam. from Drawings.	Observed Phase Angle.	Theoretic Phase Angle.	Difference between Observed and Theoretic Phase.
Sept. 13	.510	91°.6	80°.	11°.6 (?) only one.
" 14	.549	84.4	82.	2.4 poor (?) only one.
" 19	.377	104.2	96.	8.2
" 23	.299	113.7	107.	6.7
" 25	.291	114.7	114.3	.4 only one
" 26	.245	120.7	118.	2.7
" 29	.188	129.6	129.	−0.4
Oct. 16	.183	129.4	127.	2.4
" 17	.239	121.5	120.1	1.4 poor (?
" 18	.241	121.2	114.	7.2
" 19	.250	120.0	108.	12.0
" 20	.300	113.6	102.	11.6
" 24	.445	96.3	81.	15.3 { very good, examined carefully.
" 25	.535	86.0	76.1	9.9 only one.
" 28	.532	86.3	64.	22.3
" 29	.595	79.0	60.	19.0
" 30	.648	72.8	56.	16.8

39. **Amount of Loss. — Drawings.**—To discover what the absolute loss at the cusps is, we may begin by considering the case of the drawings. There we found (Art. 35) that the difference of phase loss at the centre of the terminator between the time of theoretic and observed dichotomy was 11°.9 — 9°.9, or 2°.0. Now Article 21 shows that the limb at the equator is brightest at the time of dichotomy, and Article 38 that the loss at the cusps decreases from a maximum at inferior to a minimum at superior conjunction. Both of these factors affect the phase deduced from the measures, but only the latter affects that shown by the drawings, as in their

case the phase is obtained by noting deviation from a straight line joining the apparent cusps. We see, then, that in the case of the drawings we have a differential catching up in the visibility of the cusps between theoretic and observed dichotomy of 2°. This shows again that there is a loss, but does not state its amount at either time.

40. **Amount of Loss. — Measures.** — For the loss in the case of the measures we may proceed as follows. The loss of visibility at the centre of the terminator, except when the libratory swing brings dark markings upon it, must be constant. Now it appears from Table XI. that, after making all corrections for irradiation — and inspection will show that no conceivably possible amount of correction will further materially affect the result — there is a difference of 10° between the phase loss at and near dichotomy and later on. This then would mark the loss at the cusps, other things being equal. The mean taken later on was carefully taken between dates when the centre of the terminator was as free as possible from the presence of dark markings. It must, however, be noticed (see the map) that the terminator crossed at the later period a much darker region than was the case at the time of dichotomy.

On the other hand, it is to be remembered that at most observatories the phase loss would be much greater, owing to poorer air. So that we may take provisionally 10° for the phase loss of the usual observations of Mercury.

41. **Discrepancy in Mercury's Right Ascension accounted for.** — Now the loss of the cusps and the increased value for the diameter explain a discrepancy in the right ascensions of the planet, noticed by Newcomb and published in his Astronomical Constants. He there says: —

"The reduction of the semidiameter of the planets was a point to which special attention was given. In the case of Mercury, the adopted semidiameter at distance unity was 3″.34. . . . When the published Right Ascension was that of the centre of light simply, a reduction to the true centre was computed by the empirical formula used in Washington observations. . . . It was assumed that when the illumination was such that the thickness of the crescent approached zero, the point observed would be two thirds of the way from the centre of the planet to the limb, and that when the planet was dichotomized the centre of observation would be five twelfths of the way from the centre to the limb. . . . The value of $\delta r''$ therefore indicates that there is a remarkable systematic difference in the observed Right Ascension according as the planet is east or west of the Sun, and therefore according to the illuminated side. The sign of the result shows that the reduction to the centre of the planet was

apparently too small. . . . The most natural conclusion is that the reduction from the limb of the planet or the observed centre of light, to the true centre was too small by an amount which, at the mean distance of the Sun, must have been nearly or quite a second of arc (cf. § 3). The adopted semidiameter 3″.4 seems so well established, both by micrometric measures and by heliometer measures during transits of Mercury, that such a correction to the diameter seems inadmissible."

Now if we employ the data given by the measures I have just discussed instead of those of previous ones, we shall see that the discrepancy he noticed in Mercury's right ascension is accounted for.

Taking the hitherto received value for the diameter and applying his formula, we get five twelfths of 3″.34, or 1″.39, for the correction from the centre of light to the centre of the disk at the time of dichotomy.

Now from the present study of the planet we see, first, that at the time of theoretic dichotomy there is a loss in addition to the phase loss along the terminator due to the loss of the cusps (Art. 37), and that this amounts to 10°. This loss is represented by *A B* in Fig. 1 of the diagram in Article 36.

It is the sine of 10° into 3″.77, or 0″.65.

This is the first part of the correction; there is a second. Subtracting 0″.65 from 3″.77, we get 3″.12 for the diameter of the disk actually seen. Now at the time of theoretic dichotomy this disk was not a half-moon, as theory supposes, but a crescent, of which the centre of light by Newcomb's formula would lie in consequence not five twelfths of the way, but about half way to the limb. Dividing therefore 3″.12 by 2, we get 1″.56 for the second part of the correction, which, added to 0″.65, makes 2″.21 for the whole correction from the new data. The difference of the two determinations for the correction from the centre of light to the centre of the disk is 2″.21, less 1″.39, or 0″.82. Now 0″.82 is very nearly the discrepancy to be accounted for.

42. **General Discussion of Measures.** — We shall now proceed to a general discussion of the measures; beginning by taking up Table VI., and then Tables IX. and XII. In Table VI. is given the ratio of the equatorial to the polar diameter, first as observed in the drawings, and secondly as measured micrometrically, uncorrected; in Table XI. the ratio between the same diameters of the micrometer measures for different irradiation corrections at and near the time of dichotomy: in Table XII. the ratios of the micrometric measures of the uncorrected equatorial to the uncorrected polar at superior conjunction, that is, the true uncorrected polar.

If we study the columns of the various phase ratios, angles, and differences, we shall become aware of some curious results.

43. **Effect of Testudo regio.** — To begin with, we must note that the only extrinsic or predicable cause for variation in the differences from top to bottom is to be found in the notes at the side. At the times there specified the long dark region called Testudo regio was in the act of passing over the terminator in consequence of the libration. And this happened presumably a little earlier for the measures than it did for the drawings, first, because the eye can see better when not hampered by wires near the object observed, and can therefore in the case of the terminator see a little farther out into the decreasing illumination; and secondly, because in taking the measures a somewhat higher power was used, 167 as against 140.

This is the only cause for variation which we can eliminate from the discussion by taking account of it at the start.

44. **Increase of Visibility of the Cusps.** — Considering now the respective columns of the differences of the drawings and the measures as compared with the theoretic phase, we see that the differences agree in being, both sets of them, small at and near dichotomy, then in increasing, and then in decreasing slightly again to conjunction. The increase, which for the measures culminates about March 3, is in part due to the passing of Testudo regio across the terminator. Eliminating its effect, we find a fairly steady increase starting from the time when the phase was greatest up to the time that foreshortening began to work, on approaching superior conjunction. The general cause underlying this was the increase of visibility in the cusps of the polar diameters already considered in Article 33. How definite a factor it is, is seen more clearly yet by continuing on to an even greater phase, where from its nature it became more marked. We cannot do this with the measures because of having none, but fortunately we can do it with the measures of the drawings; and this is shown in Table X.

45. **Foreshortening due to Irradiation.** — Lastly, we perceive what we should expect to find, a falling off of the differences as we approach conjunction, owing to the increase of irradiation at the terminator due to foreshortening, an apparent increase which the increase in the polar diameter is not able to overcome.

In the following ratios the polar diameter is also corrected for irradiation, a correction amounting to twice 0″.13, or to 0″.26, at conjunction, making it 7″.54. The value 7″.50 is used throughout.

TABLE XI.

RATIO OF EQUATORIAL TO POLAR DIAMETER, FROM THE MICROMETRIC MEASURES CORRECTED FOR IRRADIATION TO THREE DIFFERENT EXTENTS.

1897. Date. G. M. N.		Cor. Irr. to 0″.13 throughout.			Cor. Irr. graded to 0″.20 at Dichot.			Cor. Irr. graded to 0″.26 at Dichot.			
			°	°		°	°		°	°	
Jan.	6	.498	90.2	8.9	.488	91.4	10.1	.482	92.1	10.8	Mean 9°.0 (Jan. 6 – Feb. 13)
Feb.	9	.394	102.2	8.9	.386	103.2	9.9	.382	103.6	10.3	
"	13	.509	89.0	5.4	.500	90.0	6.4	.492	90.9	7.3	
"	19	.539	85.5	13.4	.532	86.3	14.2	.528	86.8	14.7	
"	20	.545	84.8	14.3	.538	85.6	15.1	.534	86.1	15.6	
"	21	.587	80.0	11.3	.580	80.8	12.1	.577	81.1	12.4	
"	22	.558	83.3	15.6	.551	84.1	16.8	.548	84.5	17.2	
"	23	.582	80.6	14.9	.577	81.2	15.5	.573	81.6	15.9	
"	24	.562	82.9	18.6	.557	83.5	19.2	.548	84.5	20.2	
"	28	.599	78.6	19.8	.596	78.9	20.1	.596	78.9	20.1	
Mar.	1	.590	79.6	22.2	.587	80.0	22.6	.587	80.0	22.6	
"	4	.622	75.9	22.2	21°.3 (Mar. 4, 4)						
"	4	.638	74.0	20.5							
"	5	.645	73.1	20.9							
"	6	.672	69.9	19.1							
"	8	.694	67.2	19.0	18° (Mar. 8, 8)						
"	8	.709	65.3	17.1							
"	9	.690	67.7	20.8	18°.4 (Mar. 9, 9)						
"	9	.727	63.0	16.1							
"	10	.688	67.9	22.3	21°.0 (Mar. 10, 10)	Mean 19°.0 (Mar. 5 – 23)					
"	10	.708	65.4	19.8							
"	11	.710	65.2	21.0							
"	17	.739	61.4	26.1							
"	19	.843	46.7	14.8							
"	20	.859	44.1	14.0							
"	23	.857	44.4	19.8	18°.7 (Mar. 23, 23)						
"	23	.871	42.1	17.5							
"	26	.921	32.7	14.4							

43. **Differences between Drawings and Micrometric Measures.** — The above are the points in which the two sets of measures, those by the micrometer and those from the drawings, agree. We now come to others, more interesting points, those in which they disagree. To understand them we must first consider with what the two kinds of measures are concerned. The measures of the drawings differ essentially from those of the micrometer in that the drawings are concerned solely with the apparent phase, while the micrometric measures are not concerned with the phase as such at all, but solely with the sizes of the apparent equatorial and polar diameters, from the ratio of which the phase follows as a resulting corollary. We may note in continuance that not only are the drawings directly interested in the determination of the phase, but that near dichotomy the drawings have a comparatively easy question to determine: simply the question of whether the terminator be a straight line

TABLE XII.

RATIO OF MICROMETRIC MEASUREMENT OF EQUATORIAL DIAMETER TO POLAR MERCURY WITH THREAD CORRECTIONS ONLY.

1897. Date. G. M. N.	Value of Measured Polar Diameter at Date.	Phase Angle Theoretic.	Mic. Meas. Ratio Equat. to Polar Diam.	Phase Angle of Mic. Measures.	Diff. between Theoretic and Mic. Measured Phase.		Mic. Meas. Ratio Equat. to Polar Diam.*	Phase Angle of Mic. Measures.	Diff. between Theoretic and Measured Phase.	
	″	°		°	°	°		°	°	
Jan. 6	7.06	81.3	.548	84.5	3.2		.496	90.5	9.2	
Feb. 9	7.00	93.3	.438	97.8	4.5	9.5	.393	102.3	9.0	Mean 7°.5
" 13	7.06	83.6	.557	83.5	−0.1		.505	89.4	5.8	
" 19		72.1	.588	79.9	7.8		.536	85.9	13.8	
" 20		70.5	.595	79.0	8.5	7.2	.542	85.2	14.7	13.5
" 21	7.10	68.7	.639	73.9	5.2		.582	80.6	11.9	
" 22		67.3	.609	77.4	10.1		.555	83.7	16.4	
" 23		65.7	.635	74.3	8.6	10.4	.578	81.0	15.3	16.9
" 24		64.3	.614	76.8	12.5		.559	83.2	18.9	
" 28	7.21	58.8	.644	73.3	14.5		.595	79.0	20.2	
Mar. 1		57.4	.635	74.3	16.9		.587	80.0	22.6	
" 4		53.3	.659	71.5	18.0	16.3	.618	76.3	22.8	21.7
" 4	7.31	53.3	.676	69.4	15.9		.633	74.6	21.1	
" 5		52.2	.683	68.5	16.3		.640	73.7	21.5	
" 6		50.8	.711	65.0	14.2		.667	70.5	19.7	
" 8		48.2	.730	62.6	14.4		.688	67.9	19.1	
" 8	7.36	48.2	.745	60.7	12.5		.703	66.0	17.8	
" 9		46.9	.725	63.3	16.4		.684	68.5	21.6	
" 9		46.9	.763	58.3	11.4		.720	63.9	17.0	
" 10	7.41	45.6	.720	63.9	18.3		.684	67.8	22.2	20.1
" 10		45.6	.739	61.5	15.9	15.8	.702	66.2	20.6	
" 11	7.44	44.2	.738	61.6	17.4		.704	65.9	21.7	
" 17	7.52	35.3	.760	58.7	23.4		.733	62.2	26.9	
" 19	7.60	31.9	.855	44.8	12.9		.833	48.2	16.3	
" 20		30.1	.871	42.1	12.0		.848	45.9	15.8	
" 23		24.6	.860	43.9	19.3		.846	46.2	21.6	
" 23	7.67	24.6	.874	41.6	17.0		.860	43.9	19.3	
" 26		18.3	.923	32.2	13.9		.908	35.3	17.0	

* Polar taken at 7″.80 throughout.

or not. Now this is a point susceptible of some nicety, for it is not, properly speaking, an estimate at all, but a matter of direct observation. The eye is very quick to settle whether a line be curved one way or the other. So quick is it, indeed, that the determination is in truth a criterion of the seeing at the moment, that is, of the relative amount of cusp or of terminator visible.

We come now to a deduction of some interest which follows from this. Since the drawings are our best criterion for the apparent phase, and since we know that they show more both of the centre of the terminator and of the cusps than the micrometric measures, and as at the centre of the terminator the illumination is fainter than at

the cusps in consequence of which the centre would lose more than the cusps on any loss of light throughout, we see at once that the micrometric measures can never, at dichotomy, show a less loss of phase than the drawings, though they may show more; in other words, that no correction for irradiation at the limb less than that necessary to reduce the equatorial diameter to such a ratio is admissible, *provided we are dealing with a sphere.*

For such a difference between the micrometric measures and the drawings is just what an ellipsoid would cause whose longest axis pointed to the Sun. Nor would such ellipticity be more directly revealed. For when the planet is in transit his greatest axis would be pointed directly at the Earth, since the Sun and the Earth at that moment are in the same line through his centre. It is only at the times mentioned above, at and near dichotomy, that the ellipticity would show itself.

47. **Spheric and Ellipsoidal Phase.** — This is not all. There is another curious fact to be found on comparing Tables I. and VI.

If an ellipsoid be illuminated by the light from a point in a principal plane containing its longest axis, and an observer be placed in that plane at an angle from the source of light, the phase shown by the ellipsoid will not in general be the same as that shown by a sphere whose diameter is one of the two shorter axes of the ellipsoid. It will only be so in the particular case where both the terminator and the observer are in the line of the minor axis of the ellipse made by the plane. In all other positions it will be greater or less than the spheric phase, according as the terminator is on one side or the other of the minor axis, provided the observer be between the line joining the tangential points on the circle and ellipse respectively and the minor axis. If we suppose the source of light to be in the third quadrant with the major axis to its left, which were the conditions in the case of Mercury in February, and call the angle a between the source of light and the major axis of the ellipse $\iota + \omega$, we see that, if

$\iota + \omega > 90°$, then the phase shown by the ellipse > than that shown by the sphere.
$\iota + \omega = 90°$, " " " " " = " " " "
$\iota + \omega < 90°$, " " " " " < " " " "

ι is the phase angle; while ω is the angle of libration.

To an observer, then, placed nearly in the line of the minor axis, the phase shown by an ellipsoid would suddenly change from being greater than that shown by a sphere to being less as $\iota + \omega$ passed through 90°. This would cause, in the case

of a planet whose phase was constantly increasing, a halting or even retrogression in that phase about that time.

Now in Table I. we see that $\iota + \omega$ became 90° between February 16 and 17. Turning to Table VI. we note that between February 16 and 17 occurred a sudden halt and retrogression in the phase.

48. **Phase of Measures.** — Thirdly, it will be noticed that the micrometric measures do not keep step with this halting of the measures got from the drawings. The former keep on more evenly, are bigger than the latter up to February, and then lose. This is precisely what should happen if the planet were an ellipsoid with its longest axis at the point of mean libration; for this was all the time getting squarer to the line of sight up to February, in consequence of which the equatorial diameter would increase up to that time, thus offsetting the loss on the terminator due to that terminator's passing through the minor axis of the ellipse, which fact alone was taken account of by the drawings.

49. **Mercury probably an Ellipsoid.** — All this is interesting from being apparently but a curious concatenation of circumstances; for though there is very little doubt that Mercury is such an ellipsoid, its longest axis pointing to the Sun, its middle one being perpendicular to this in the plane of the ecliptic, and its shortest being the planet's polar axis, there is also but little doubt from theory that the difference in the diameters is much too small to be visible, even indirectly. For each of these phenomena may be otherwise explained. Article 46 is explicable by greater irradiation at the centre of the limb; Articles 47 and 48, by the passing of Testudo regio across the terminator.

50. **Summary.** — These observations, therefore, go to show that Mercury is: —

(1) A body somewhat larger than has been supposed; its polar diameter subtending at distance unity about 7″.50, equivalent to about 3,400 miles. From the difficulty of evaluating the irradiation I consider that this is probably too large, and that 3,300 miles is nearer the truth. The older measures, however, are certainly too small.

(2) Of a probable density much less than the Earth's, and according, within errors of observation, with what *a priori* principles of size and solar position would lead us to suppose;

(3) Of a probable mass, from (1) and (2), between the older and later determinations, — about $\frac{1}{20}$ of the Earth's;

(4) Rotating in 87.969 days, its orbital period. The decimal is here given because though the period of rotation may differ by a minute amount from the

orbital period, no such deviation has been observed and it is very unlikely that any exists; especially as

(5) There seems to be evidence that it has rotated thus from the time it was plastic;

(6) About an axis approximately perpendicular to the plane of its orbit;

(7) Possessing no certain signs of atmosphere;

(8) Nor sign of water;

(9) Nor of vegetation;

(10) Nor of organic life;

(11) Covered with long narrow markings best explained as the results of cooling;

(12) Somewhat symmetrically disposed, thus suggesting (5);

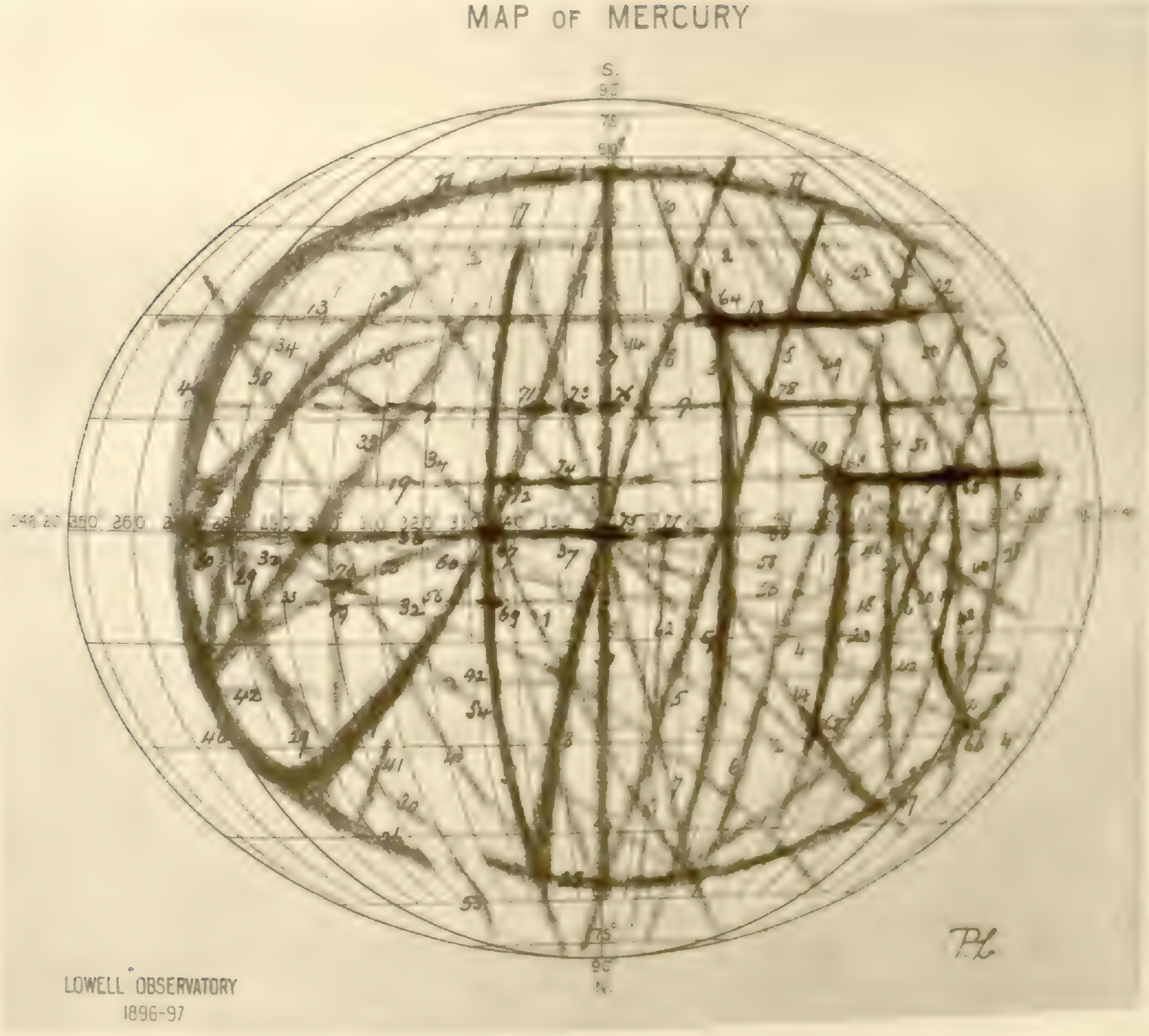
(13) A world as dead as the Moon, but differently brought to such condition.

INDEX TO PLATE XXVII.

1. Maia.
2. Hypate.
3. Zugon.
4. Thoth.
5. Oneiraton.
6. Ala.
7. Cyllene.
8. Psychopompos.
9. Lichanos.
10. Petasus.
11. Keras.
12. Agetor.
13. Parhypate.
14. Hegemonios.
15. Enodios.
16. Agoraios.
17. Caduceus.
18. Empolaios.
19. Mese.
20. Anguis.
21. Serpens.
22. Keryx.
23. Diemporos.
24. Pedilla.
25. Cornu
26. Talaria.
27. Plectron.
28. Ebur.
29. Corneus.
30. Somnus.
31. Oneiropompos.
32. Poimandres.
33. Psychagogos.
34. Trismegistos.
35. Aphorismos.
36. Paramese.
37. Kuranides.
38. Smaragdina.
39. Chlamys.
40. Testudo.
41. Pteron.
42. Paranete.
43. Nomios.
44. Dolios.
45. Lichanos.
46. Sokos.
47. Pheneos.
48. Phara.
49. Pelene.
50. Carvara.
51. Kephalos.
52. Hegemonios.
53. Vayu.
54. Turms.
55. Necropompos.
56. Trite.
57. Hermes.
58. Boukolos.
59. Kriophoros.
60. Polygios.
61. Promaxos.
62. Sarameya.
63. Mese meson.
64. Parhypate hypaton.
65. Mese hypaton.
66. Nete hypaton.
67. Paramese hypaton.
68. Nete meson.
69. Trite diezeugmenon.
70. Trite hyperbolæon.
71. Lichanos hyperbolæon.
72. Mese hyperbolæon.
73. Lichanos synemmenon.
74. Mese diezeugmenon.
75. Paramese meson.
76. Lichanos meson.
77. Paramese hypaton.
78. Lichanos hypaton.

The names have been given in accordance with the suggestion of the markings themselves whose outline is singularly like the tortoise-shell lyre invented by the god; the lines along the parallels of latitude being the strings and the conspicuous marking 29 representing the plectron.

MAP OF MERCURY



MERCURY.

Sept. 2—4h 32m
λ=64°

Sept. 2—5h [illegible]
λ=[illegible]

Sept. 2—5h 15m
λ=64°.

Sept. 3—4h [illegible]
λ=[illegible]

Sept. 3—5h
λ=[illegible]

Sept. 3—5h 15m.
λ=65°.

Sept. 5—[illegible]
λ=[illegible]

Sept. 6—5h [illegible]
λ=7[illegible]

Sept. 13—5h 20m.
λ=65°.

Drawings by Percival Lowell.

Lowell Observatory
October [illegible]

MERCURY.

[illegible]

[illegible]

Sept. 3, '00—5h 20m.

[illegible]

Sept. [illegible]

Lowell Observatory.

Drawn by D. A. Drew.

MERCURY.

Triad of Drawings Oct. 27-28.

Triad of Drawings Oct. 28-29.

Triad of Drawings Jan. 5-6.

LOWELL OBSERVATORY. 1896-7

THREE TRIADS OF DRAWINGS,

SHOWING SLOW ROTATION.

DRAWINGS BY MISS LEONARD.

MERCURY.

Oct. 29—22h 20 m.

Oct. 29—23h 0m.

Oct. 30—4h 2m.

Triad of Drawings Oct. 29-30.

Nov. 1—21h 36m

Nov. 2—0h 38m-45m.

Nov. 2—[illegible]

Triad of Drawings Nov. 1-2.

Nov. 4—22h 50m.

Nov. 5—0h 11m-19m.

Nov. 5—21h 39m-46m.

Triad of Drawings Nov. 4-5.

THREE TRIADS OF DRAWINGS, THREE DAYS APART

SHOWING SLOW ROTATION.

MERCURY.

Oct. 19—23h 45m.
ι=102°. ω=-4°.

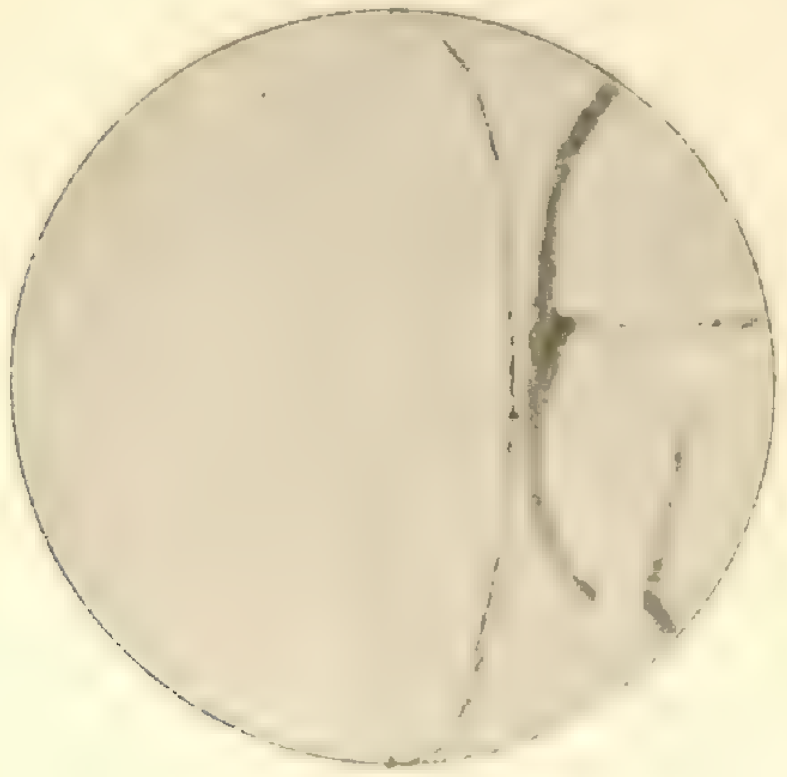
Oct. 24—23h 38m–Oct. 25—0h 4m
ι=76°. ω=-15°.

Oct. 28—22h 40m–57m
ι=60°. ω=-20°.

Oct. 31—23h 18m–32m
ι=40°. ω=-23°.

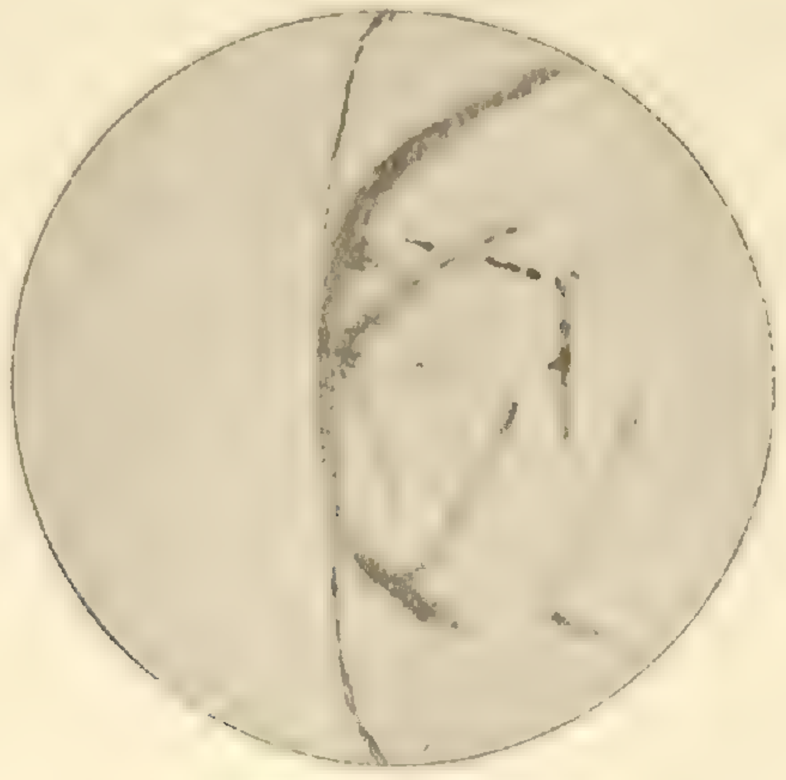
Nov. 8—22h 54m–23h 8m.
ι=28°. ω=-23°.

1896.

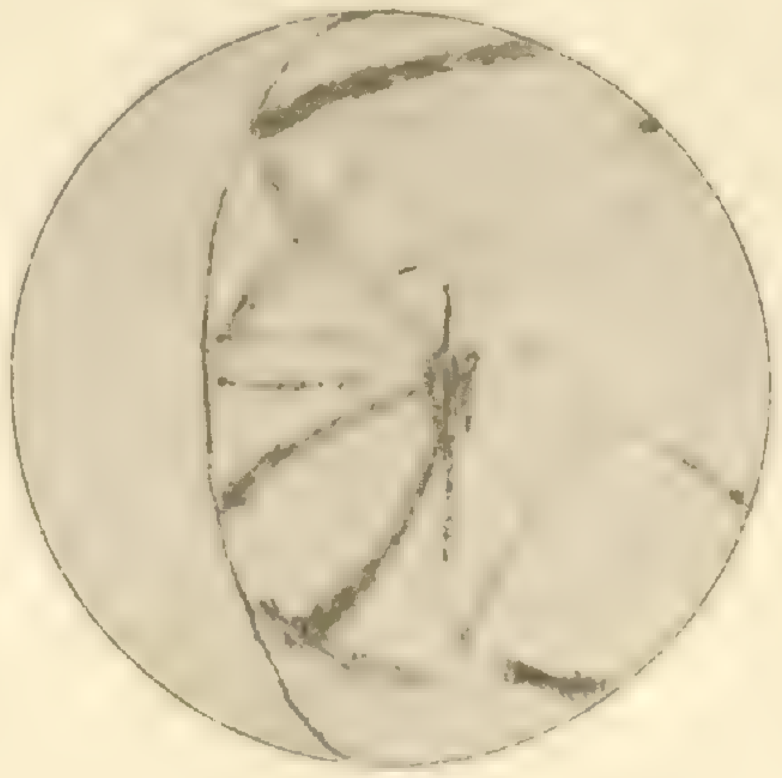


Feb. 5—23h 23m–37m.
ι=102°. ω=-22°.

Feb. 14—21h 40m–22h 2m.
ι=82°. ω=-16°.



Feb. 27—22h 19m–28m.
ι=60°. ω=0°.



Mar. 3—20h 35m–48m.
ι=55°. ω=+5°.

Mar. 20—19h 56m–20h 14m.
ι=28°. ω=+23°.

1897.

ι=the angle between Sun and Earth at Mercury.

ω=the angle of libration.

LIBRATION

DUE TO THE ECCENTRICITY OF THE PLANET'S ORBIT

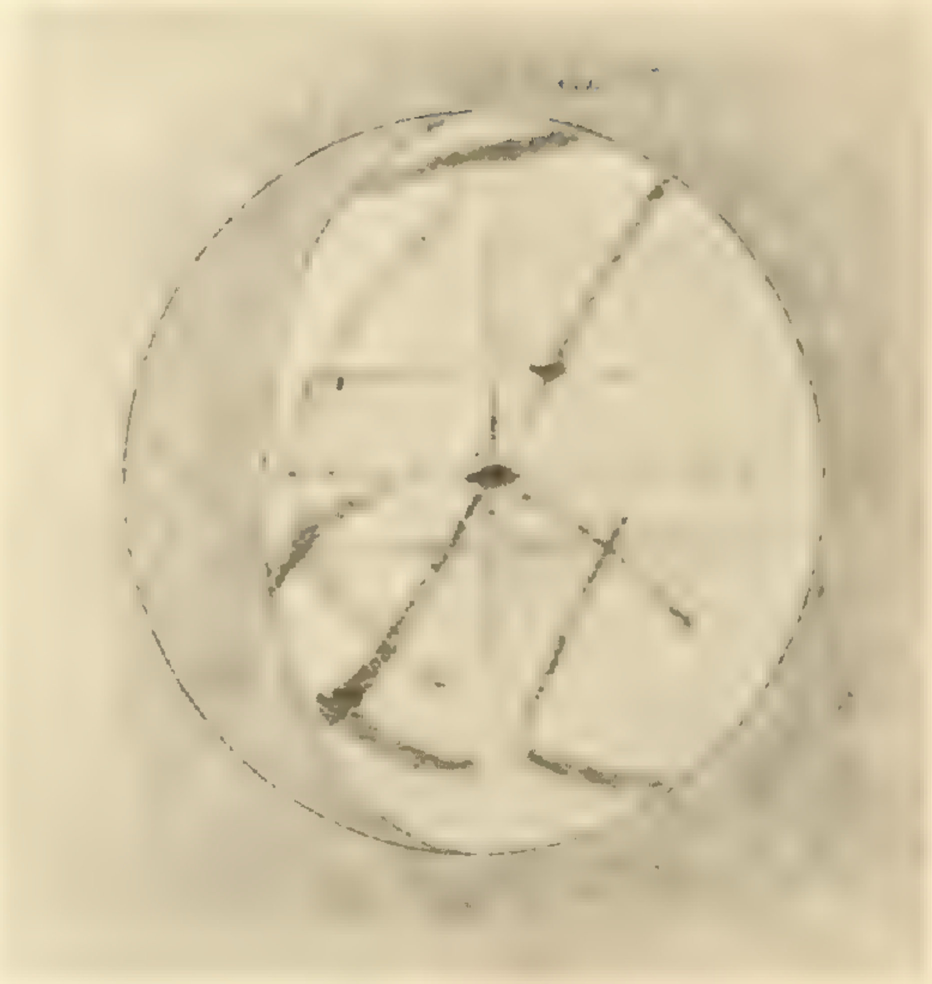
MADE VISIBLE BY THE MARKINGS.

LOWELL OBSERVATORY, 1896–7.

All the Drawings are by Percival Lowell.

MERCURY.

Mar. 5—20h 28m.



Mar. 7—20h 3m–29m.

Mar. [illegible]

Mar. 9—19h 47m–20h 4m.

Mar. 10—19h 40m–52m.

Mar. [illegible]

Mar. 13—19h 36m–43m.

Mar. 14—20h 7m–17m.

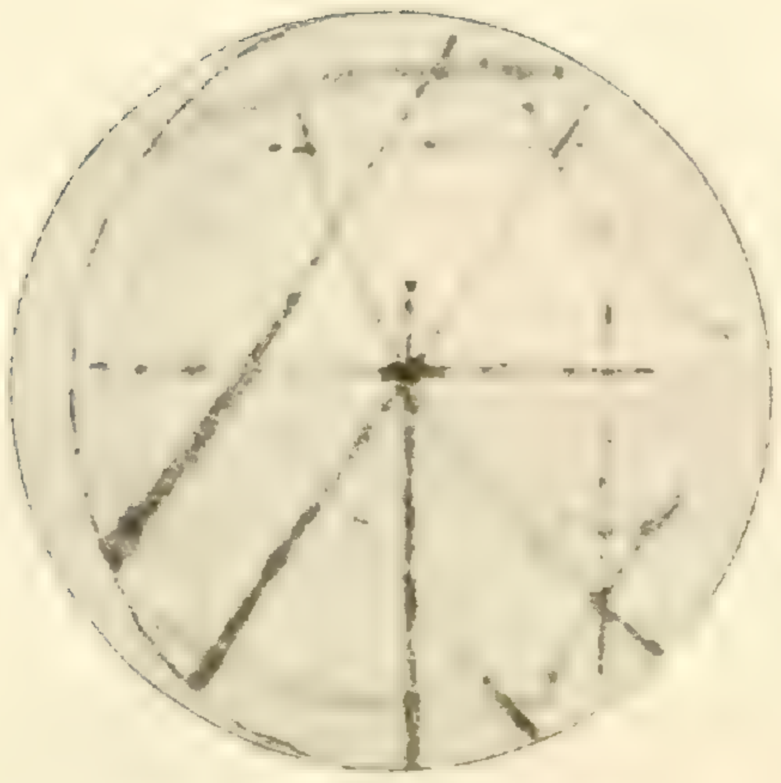
Mar. [illegible]

MERCURY.

Mar. 17—19h 51m–20h 0m.

Mar. 18—19h 38m–47m.

Mar. 19—20h 8m–37m.

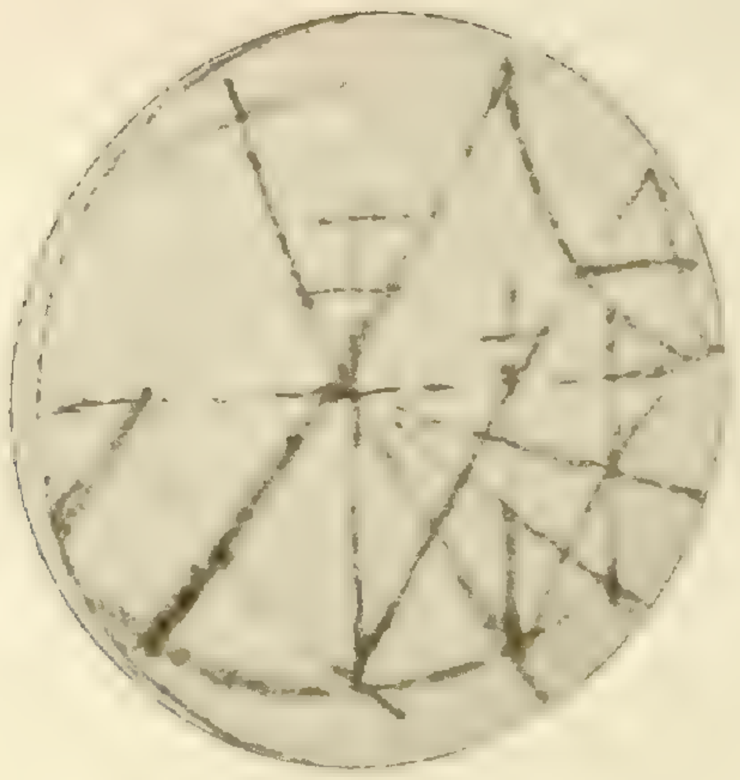


Mar. 20—19h 56m–20h 14m.

Mar. 21—20h 43m.

Mar. 22—[illegible]

Mar. 25—20h 7m–27m.



Mar. 26—21h 33m–50m.

Mar. [illegible]

LOWELL OBSERVATORY.
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OF

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V.

I. EXPERIMENTS ON THE EFFECT OF FREEZING AND OTHER LOW TEMPERATURES UPON THE VIABILITY OF THE BACILLUS OF TYPHOID FEVER, WITH CONSIDERATIONS REGARDING ICE AS A VEHICLE OF INFECTIOUS DISEASE.

II. STATISTICAL STUDIES ON THE SEASONAL PREVALENCE OF TYPHOID FEVER IN VARIOUS COUNTRIES AND ITS RELATION TO SEASONAL TEMPERATURE.

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WITH EIGHT PLATES.

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PART I.

I. INTRODUCTORY.

In view of the fact that the micro-organism which is commonly considered to be the cause of typhoid fever appears to be able to survive for longer or shorter periods in the environment of man, it becomes important to discover, as nearly as may be, its behavior under various natural conditions. Some knowledge of this kind we have already in the case of heat and light; some, also, in respect to low temperatures under certain conditions. But a careful review of the present state of our knowledge in regard to the influence of cold upon the bacillus of typhoid fever shows that much still remains to be done in order to make our knowledge in this direction more precise.

The subject assumes great practical importance when we begin to consider the influence of external conditions upon the longevity of the bacillus in nature, particularly in those regions in which there is a considerable variation of climate. It was a theory formerly widely held that the specific organism of typhoid fever was not only capable of enduring for a long time outside the human body, but even that a residence in earth, filth heaps, and the like was an essential phase in its life history. Modern researches have thrown grave doubt upon this earlier theory, but at the same time rigid inquiry into epidemics and further knowledge of the disease itself have shown how readily the micro-organism may become widely distributed in the environment. Prolonged and careful studies of the influence of temperature upon the bacillus of typhoid fever, have led us to believe that this factor plays a part in the seasonal distribution of the disease which is of the highest importance, making it possible to explain, by the co-operation of this and other factors, such as light and dryness, certain phenomena hitherto inexplicable or little understood. An obvious and direct application of the principles worked out concerns one of the principal food supplies of man, and an important section of the following paper is therefore devoted to a consideration of the danger of the conveyance of the disease in question by polluted ice.

II. A REVIEW OF THE LITERATURE RELATING TO ICE AS A VEHICLE OF DISEASE AND TO THE BACTERIOLOGY OF ICE.

A. INFECTIOUS DISEASES ATTRIBUTED TO POLLUTED ICE AND ICE-CREAM.

THE interest of the authors in this subject was first aroused by the practical questions connected with ice supply and the public health. As will appear in the paragraphs immediately following, diseases, and particularly typhoid fever, have not infrequently been attributed to impure ice.

The first outbreak of disease directly ascribed to this source was reported in this country in 1875,[1] at the summer resort of Rye Beach. Dr. Nichols of Boston, who was called in to investigate the affair, found the illness, a more or less severe intestinal disorder, confined to the guests of one of the two large hotels of the place. The other hotel and adjacent cottages were unaffected. The milk and water supplies and the drainage appeared above suspicion. The ice for the hotel, however, was cut on a small pond whose waters were rendered very foul by a mass of putrescent matter, composed of marsh mud and decomposing sawdust. A chemical analysis of the ice, and of the water from the pond, showed high total organic matter and high ammonia, both free and albuminoid. Three cases of the disease outside the hotel directly following the use of this ice made the evidence still stronger. Three years later Dr. Smart, U. S. A.,[2] attributed some cases of a "malarial remittent fever" in a Rocky Mountain army post to the contamination of mountain streams by melting snow. The high organic content of the water in early spring was probably due to this cause, and he believed that the "*materies morbi*" of malaria had a similar origin. In the summer of 1879 an outbreak of dysentery occurred in Connecticut which is discussed in the Second Report of the Board of Health of that State.[3] Out of the eleven persons, including the family residing in a certain farmhouse, two hired men, and relatives who came to assist in nursing, there were eight cases of dysentery, three of them fatal, and two cases of persistent diarrhœa. The drinking water in use gave satisfactory results on analysis, but the soil adjoining the house was damp and polluted, and the ice used came from a small stream which served as a running place for pigs. Analysis of the ice-water showed high ammonias, and this appeared to the

investigators the most probable cause of the disease. In the Report of the same Board for 1882,[4] an interesting single case of typhoid fever is cited as probably derived from ice. The patient had lived alone for some months in a house whose sanitary conditions were apparently perfect. He was inordinately fond of ice-water, and the ice for his house was cut on a small pond near by. It appeared on investigation that the drains from some laborers' houses emptied directly into the pond, and that in these houses there had been three cases of typhoid fever during the previous summer. Attention was also called to the general danger from ice supply, by the Connecticut State Board of Health in 1880, by the Massachusetts State Board in 1876 and 1889, by the Michigan Board in 1882 and 1884, by the New Hampshire Board in 1882, the New York Board in 1886, the Minnesota Board in 1886, and the sanitary authorities of Chicago in 1896 and of Milwaukee in 1876.

Duclaux[5] appears to have been the first European to give the matter marked attention, although a recent French writer[7] mentions an ice epidemic at "Eveshem," in 1882, of which we have found no other account. Duclaux enlarged at length upon the danger from ice, especially the artificial ice made in Paris from the water of certain highly polluted canals. In 1893 Professor Riche[6] made a long report to the *Conseil d'hygiène et de salubrité de la Seine* upon the dangers to the inhabitants of Paris from the sale of highly polluted ice. He quoted a letter from Pasteur as follows: "Le docteur Roux vous a dit son opinion, et c'est aussi la mienne, que toute eau impropre à la boisson l'est également pour préparer, en hiver, de la glace pour l'alimentation. Les microbes inoffensifs ou pathogènes résistent presque tous à des températures même très basses." M. Riche showed that much of the Paris ice came from contaminated sources, and recommended strong legal restrictions upon its sale. Finally, Dr. Dorange, in the *Revue d'Hygiène*,[7] described a supposed ice-epidemic of typhoid fever at the military post of Rennes in the autumn of 1895. Eight lieutenants of the regiment there stationed were taken ill between the twelfth and the twenty-fifth of December. The fact that these officers did not habitually live in common but had all been present at a regimental banquet upon the fourth of December, pointed to that occasion as the moment of infection. The higher officers dined in a separate room, and used no water but the town supply, which was excellent. The lieutenants, on the other hand, drank a "tisane" of champagne mixed with chilled water. The man who provided this claimed that it also was derived from the regular town-supply. The fact that the town water could be obtained by him only from a considerable distance and under strict police regulations, led Dr. Dorange to suspect that he had made use of the water in a reservoir which stood in the room

where he cooled his decanters and which received the meltings from his stock of ice. The ice supply of the town was considered highly polluted. The additional facts are cited that the menus of the different classes of officers were the same, and that certain of the petty officers who did not drink from the "tisane" but made use of beer instead, escaped the disease.

Altogether it appears probable that the milder intestinal disorders, caused by mere decomposing organic matter and not by specific germs, have at times been caused by polluted ice. The Rye Beach epidemic was carefully and thoroughly studied, and leads directly to that conclusion. With respect to typhoid fever the case is different. The only ice-epidemic of typhoid fever which has come to our notice, viz., that at Rennes, rests on a doubtful chain of circumstances, and lacks the confirmation of a complete exclusion of all possible factors other than ice. We have been unable, then, to find any conclusive evidence that typhoid fever has been caused by polluted ice-supply.

A number of English epidemics of typhoid fever, more or less clearly traced to ice-cream, should be noticed here, although the conditions are quite different from those which obtain in the case of ice. The first of these epidemics occurred in the English sanitary districts of Greenwich and Rotherhithe in 1892.(8) During the last week of September and the two months next following 511 cases were reported, the beginning of the attack in 15 per cent of the cases falling on October 1 and in 57 per cent of the cases falling in the fortnight preceding October 3. A remarkably large proportion of the victims were young children. The water supply and sewerage of the four separate foci of infection were different and apparently all in good condition. The milk supply of the households attacked came from seven dairy farms, and in many cases consisted only of condensed milk. Suspicion was then directed to the ice-cream sold by Italians from barrows in the street. A careful canvass of one neighborhood in which 56 cases of typhoid fever had occurred showed that 924 persons lived in houses where ices had not been eaten, 232 lived in houses where ices had been obtained from shops, and 395 in houses where ices had been obtained from a certain ice-cream vendor. All the cases of typhoid fever were in this latter class. A detailed examination of the cases in all the infected areas showed that 88.9 per cent of the sufferers had eaten ices, and that, of these, 91.4 per cent had obtained their supply from ten Italian vendors living in a certain Mill Lane, of whom one was the dealer above mentioned. The sanitary conditions in Mill Lane were found to be abominable; and in the family of one of the purveyors of ice-cream two children had sickened with typhoid fever on July 29 and August 5 respectively.

An epidemic of typhoid fever which attacked over 800 persons in the county of Renfrew, in Scotland, in 1893, was attributed by Dr. A. C. Munro partly to ice-cream and partly to the public water-supply.[9] Out of the first 180 cases 63 were shown to have eaten ice-cream prepared by a dealer in whose family a case of typhoid fever had occurred during the previous month. The patient had been in intimate contact with the ice-cream business during the greater part of her illness.

Vaughan and Perkins, in 1895,[10] ascribed two epidemics of severe, but not fatal, intestinal disease to a new pathogenic bacillus which they isolated from ice-cream in one case and from cheese in the other. The germ belonged to the colon group, and the authors note that neither twenty-nine days of continuous freezing nor alternate freezing and thawing could destroy its vitality.

Dr. Hope, in 1898,[11] studied an epidemic affecting 27 school children in Liverpool in which the only clue appeared to be the presence of all the patients at a fair just at the time of infection. Here 24 of the children had eaten ice-cream and two more had partaken of "chip" potatoes sold by an Italian in whose house there had been two cases of typhoid fever.

In these cases of infection from ice-cream there is, of course, no certainty that the disease germs were actually frozen. The possibility of contamination from spoons, vessels, and the hands of the vendor might easily account for all the phenomena. Even if the infection was really carried in the ice-cream the exposure to a low temperature must have been a relatively short one. The same reasoning applies to the famous Plymouth, Pa., epidemic of typhoid fever. This little mining town had 1200 cases of the disease and 130 deaths among its 8000 inhabitants in 1885, and the investigation[12] clearly traced the infection to the dejecta of a single typhoid fever patient which were thrown out on the snow on the banks of the brook supplying the town with water, and which had been washed in by the first general thaw of the spring. It may easily have been that the discharges thrown out during the day or two preceding the thaw were never really frozen at all. In any case the conditions affecting germs imbedded in a solid mass of rich food material are quite different from those which obtain in the formation of ice upon a stream or pond.

B. BACTERIA IN NATURAL ICE, SNOW, AND HAIL, AND IN ICE-CREAM.

In spite of the absence of epidemiological evidence, it has been the common opinion of sanitarians that ice might be an important source of infection for typhoid fever or any other germ disease. Its apparent purity was shown by the earliest bacteriologists to be deceptive. Burdon-Sanderson,[13] in 1871, found that liquid

culture media showed bacterial growth when inoculated with melted ice or with snow. In the next year, Cohn [14] described experiments in which nutrient solutions containing bacteria were not sterilized by exposure to a temperature ranging as low as –18° C. for about 6 hours or by a temperature with a minimum of –7° C. for 18 hours.

Professor Joseph Leidy, in 1884,[15] exhibited, at a meeting of the Academy of Natural Sciences at Philadelphia, snow water derived from melted ice, containing not only Infusoria but also Rotifers and Worms. Pohl, in the same year,[16] recorded the finding of many bacteria in snow and ice, 110 per centimeter in Neva ice, and 20,774 in one sample of bubbly ice. He also found bacteria in falling snow, the number decreasing with the continuation of the storm. A report on the ice supply of the city of Syracuse[17] was made to the New York Board of Health in 1886 in which the presence of a great number of bacteria was noted in ice from Onondaga Lake and the Erie Canal. In 1888 Breunig [18] found 1310–2760 germs in ice, and Kowalski [19] analyzed sixty samples of natural ice, and found from 10 to 1000 germs per cubic centimeter, no sample being sterile. Still another paper was published at this period, 1888–89, by Heyroth,[20] who studied the Berlin ice-supply, and, in 25 samples, found from 2 to 133,000 bacteria per cubic centimeter, the highest figures corresponding to chemical analyses which showed the most marked pollution. An elaborate report was made by the State Board of Health of Massachusetts in 1889,[21] in which 238 samples of natural ice from the ponds and streams of this State were analyzed bacteriologically. The figures for ice from different portions of the cake were as follows: —

	Number of Samples.	Bacteria per c.c.		
		Maximum.	Minimum.	Average.
Transparent Ice	27	893	0	105
Clear Ice	75	370	0	15
Bubbly Ice	113	1950	0	111
Snow Ice	23	2968	0	622

A "Lancet" analytical sanitary commission made an examination of some ice sold in London in 1893, and found that while all the specimens gave good chemical analyses, two out of the six examined contained 400 to 700 bacteria per cubic centimeter.[22]

Girard and Bordas[23] published some startling analyses of the Paris ice-supply also in 1893. They found a minimum of 23,000 colonies and a maximum of 100,000 colonies per cubic centimeter, including the Bacillus coli communis and a patho-

genic vibrio. These quantitative results are so large as to suggest that the samples were probably not planted promptly after melting.

Christomonas[24] has recently studied artificial ice, and reports that when water containing 71 bacteria per centimeter was frozen, 450 germs per centimeter were found in the central core and 8–10 in the clear ice at the sides.

The bacteria of snow and hail have also received considerable attention. Soon after the work of Pohl,[16] Janowsky[25] made analyses of old and of freshly fallen snow in the neighborhood of Kiew, and found bacteria in both, less in the former than in the latter. Schmelk[26] studied the bacterial life in the snow of a Norwegian glacier and in the chill streams flowing therefrom; and in a later paper[27] he recorded small numbers in both snow and ice at Christiania. Bujwid[28] found 21,000 bacteria per cubic centimeter in the analysis of a melted hail-stone; and Foutin[29] in Russia obtained similar, though smaller, figures.

Giacosa[30] found bacteria present in small numbers in snow lying at an elevation of 3800 meters above the sea, and Abbott[31] noted 703 colonies per cubic centimeter in hail. Dominguez,[32] in 1892, published a paper on the bacterial content of hail; and finally, Scofone,[33] who accompanied a scientific expedition to Monte Rosa in 1894–95, recorded the presence of small numbers of bacteria in melted snow obtained from high altitudes. In the following year he gave the results of some examinations made on a plateau 2460 meters above the sea, which confirmed his previous conclusion that the bacteria in the deeper layers of the snow were somewhat more numerous than in the superficial layers.[34]

The number of bacteria present in ice-cream has been shown at times to be enormous. Klein[35] found the germ content of London ice-cream very high, and B. coli communis frequently present. Nield-Cook[36] recorded from 5,000,000 to 14,000,000 germs per cubic centimeter in ice-cream from the same source, the majority being colon bacilli. Stevenson[37] testified, at the trial of an Italian ice-cream vendor, that he had found over 4000 germs per cubic centimeter, of which three proved to be B. coli communis. Wilkinson[38] reached similar results, and quoted, without reference, the following results of other observers: —

Macfadyen	119,000 – 7,000,000	bacteria per cubic centimeter.
Kanthack	8,000,000 – 13,000,000	" " " "
Foulerton	500,000 – 7,000,000	" " " "

In this connection it may be interesting to note the very small numbers of bacteria present in the air and water of the Arctic regions. Nystrom[39] discovered this fact in 1868 by the exposure of a number of flasks of putrescible matter, after the

manner of Pasteur. Couteaud[40] found but one colony in 19 flasks exposed to Arctic air, the experiment being carried on, however, on the open sea, so that the result is not surprising. He also found but few species present in some analyses of water and of soil. In the Nansen expedition the poverty of the bacterial flora of the air was noted. Finally, Dr. Levin[41] of Stockholm made an elaborate study of the subject with the Natthorst expedition. In 21,600 liters of air examined at twenty different places 3 germs alone were found, all in one sample. In sea water, at the surface, 11 germs per centimeter occurred, belonging apparently to two characteristic species. Fresh water and melted ice and snow gave similar small numbers. Samples from considerable depths in the ocean showed somewhat higher numbers than were obtained at the surface. Finally, tests of the alimentary canals of various Arctic animals and birds showed many of them to be completely sterile.

C. FXPERIMENTS ON THE EFFECT OF FREEZING AND OTHER LOW TEMPERATURES UPON THE VIABILITY OF BACTERIA.

Laboratory experiments have confirmed the conclusion, drawn from the examination of natural ice, that freezing is by no means always fatal to germ life. Von Frisch[42] froze putrefying solutions and reduced the frozen mass to a temperature of −87° C., and after some hours found that sterilization had not ensued.

Pictet and Young[43] subjected bouillon cultures of several species to a temperature below −70° C. for 108 hours, during twenty hours of which time the temperature was below −130°. After this treatment B. anthracis and the bacillus of "charbon symptomatique" were alive and virulent; B. subtilis and B. ulna grew readily; half the inoculations made from the cultures of two species of micrococci grew and half did not. Finkler and Prior[44] stated that the vibrio described by them could survive a temperature of −4° C. for many days. McKendrick,[45] in a communication to the British Association in 1885, noted that putrescible liquids were not sterilized by a temperature of −84° C. Forster[46] found that the phosphorescent bacteria which he isolated from fish preserved by cold storage grew vigorously at 0° C. Fischer[47] isolated 5 species of bacteria from the water of the harbor at Kiel, and 9 other forms from the soil, all capable of multiplying at 0°. In the research already cited,[20] Heyroth froze gelatine stick-cultures of various species for from seven to ten days, and then placed them once more under favorable conditions; out of 30 species, thus treated, 25 showed growth, though 5 of these had partially lost their liquefying power. D'Arsonval,[48] in 1891, recommended liquefied carbonic acid for use in sterilizing organic extracts, and stated that when the treatment is prolonged, especially

if broken by a return to 40° for a time, "nothing living can resist it," but his own and other later researches showed the error of this conclusion. Forster, in 1892,[49] examined various natural waters, foods, wastes, sweepings, and soils for bacteria capable of growth at 0°, and found a few such forms in water, earth, and street sweepings. When present at all they occurred in great numbers. Forster also demonstrated the multiplication of bacteria and the progress of decomposition in butcher's meat chopped up and kept in an ice calorimeter. Fischer[50] noted that Miller's vibrio and the vibrio of Finkler and Prior could withstand a freezing temperature for some days.

Pictet, in 1893,[51] studied the effect of cold on plants and animals of the most widely separated classes. Of the bacteria he subjected 30 to 35 species to temperatures ranging as low as –200° C. by immersing them in liquid air, but the viability of the germs used appeared unaffected after "prolonged" treatment of this sort. D'Arsonval and Charrin[52] subjected cultures of Bacillus pyocyaneus to a temperature of –40° to –60° C. with the result that, in six out of eight instances, the germs remained alive.

In another paper[53] these authors mentioned that Bacillus pyocyaneus after exposure to –40°, –60°, and –95° C. exhibited profound changes in morphology and physiology. For some generations the descendants of the frozen germs showed elongated, ovoid, and other abnormal forms, and their colonies on gelatine were also of unusual character. Weber[54] noted that Hofer's bacillus, producing a contagious disease among Crustacea, can endure a temperature of –40° C. for four hours, as well as repeated thawings and freezings.

Professor Mason[55] recorded the exposure of cultures of "ordinary bacteria" to the temperature of solid carbon dioxide for many hours without causing their destruction. Still more recently Ravenel[56] submitted cultures of the anthrax, diphtheria, and typhoid bacilli, and of Bacillus prodigiosus to the temperature of liquid air, 191° below zero Centigrade, for periods of three hours, thirty minutes, one hour, and one hour respectively; in no case could any weakening of the vegetative power of the culture be detected.

Besides Pictet and Young[43] and Ravenel[56] a number of other observers have tested the effect of low temperatures upon specific pathogenes. Cadéac and Malet[57] found that tuberculous matter kept frozen for four months still produced characteristic symptoms in guinea pigs. In some work on the spores and vegetative forms of Bacillus anthracis carried out by one of the Franklands and Dr. Templeman,[58] it was found that a single freezing at –20° C. reduced the numbers present in water from

15,000 to 3500 per cubic centimeter, and after 29 successive freezings, extending over a period of three months, 3000 germs per centimeter could still develop. Evidently the vegetative forms were killed by one freezing, and the spores, not at all. Another culture which was spore-free showed reduction from 8000 germs per centimeter to 2 per centimeter after one freezing, sterilization following the second freezing.

Gabritschewsky, Wladimiroff, and Kressling and Gladin quoted by Kasansky (59) found that the plague germ could bear an artificial cold of −22° C. for two hours and natural cold ranging from 0° to −20° C. for from twelve to forty days. Kasansky himself in 1897–98 made some interesting experiments on the resistance of the specific organisms of plague and diphtheria against cold. The cultures were placed outside the window of the laboratory at Kasan, sheltered from light but exposed to the winter's cold, which ranged from a maximum of 5° C. to −34° C. Bouillon cultures of the plague germ showed life after thirty-two days; four months' exposure sterilized most of the tubes, but in one case growth was obtained after six months. Of the agar cultures tested some died in four months, and others contained living germs after five months and a half. Sixteen bouillon tubes of the diphtheria bacillus were kept for six months under similar conditions, and one tube only showed growth at the end of that time; two of the others, however, still gave positive results on the fifty-third and one hundred and eighteenth day, respectively.

Abel (60) exposed cultures of the diphtheria germ on blood serum and on dried threads to the winter's cold at Greifswald, and compared them with cultures kept in the room in the same condition. The first race used persisted on the blood serum for the whole period of eighty-six days both in the room and out of doors, although in the second case the growth obtained was meagre after the fiftieth day. The dried germs had disappeared by the sixty-eighth day out of doors and by the seventy-fourth indoors. Of the second race the serum culture remained alive in the room all through the experiment; the frozen one showed no growth after the seventy-fourth day. The threads gave living germs up to the seventy-fourth day in-doors and up to the fifty-sixth day out-doors. The threads of the third race gave precisely the same result; the serum cultures kept in the room gave vigorous growths up to the end of the experiment, while only two colonies developed from the inoculation of the frozen tube. The out-door temperature during the experiment varied from 12° C. to − 20° C.

With regard to the behavior of the typhoid bacillus in ice, there is more evidence available. Dr. Carl Seitz (61) noted in 1886 that cultures of this organism in gelatine, bouillon, and milk were not rendered sterile by the continuance of a temperature

below 3° C., although the growth on gelatine at the low temperature was very much retarded. Dr. Billings, in this country,[62] described a single experiment in which five cubic centimeters of sterile water were inoculated with the typhoid germ and frozen by the out-door cold. On the next day the frozen mass was thawed, and three gelatine tubes and one agar tube were inoculated with portions of it. Three of the four tubes showed typical growths. Chantemesse and Widal[63] recorded the freezing of bouillon cultures of the same microbe without sterilization. Bashenow[64] stated that typhoid germs survived exposure for thirteen days to a temperature between −8° and −15° C. Janowsky published in 1890 some very extended researches[65] in which he used pure cultures of the typhoid bacillus in bouillon and froze them by means of ice and salt, ice and chloride of calcium or carbon dioxide and ether. He made no quantitative estimations; but bouillon frozen by each of the above methods could still produce growth in Esmarch roll-tubes. Janowsky tried also the effect of successive freezings, using the calcium-chloride mixture. After the culture had solidified, it was left in the freezing mixture for fifteen minutes, then thawed in a water bath at 25°–30° C., a sample taken, and the cycle repeated. This was done three times a day; and during the night the culture was kept at 2°–5° C. After twelve such freezings sterilization had not been accomplished; the development of the frozen bacilli was, however, much retarded. To imitate more closely the conditions in nature, Janowsky placed a bouillon culture and two flasks in which were threads bearing the germ in a dried condition, in a wire cage out of doors. Four sets of experiments were conducted, in three of which periods of seven, ten, and twelve days, respectively, did not suffice for sterilization. In the fourth set of cultures the bouillon tube showed no growth after nineteen days; the minimum temperature during the period had been −17° C. and the maximum 4°, the culture thawing and freezing three times. Finally, among experiments on the typhoid bacillus must be mentioned a remarkable paper by Remlinger,[66] in which he states that he used a culture of B. typhi of such virulence that .5 c.c. would kill a guinea pig in 36–48 hours. He took agar cultures of this germ out of the incubator every two or three hours to immerse them in water, cooled down to 22°–23°, for ten minutes. After ten days of this treatment the cultures had entirely lost their virulence, and after thirty-five days their power of growth as well. The author does not state whether control experiments were made or not.

Even more extensive is the literature with respect to the effect of cold on the cholera vibrio. Koch, the discoverer of the organism, stated that it was not destroyed by a temperature of −10° C. in ten hours.[67] Raptschewski[68] found that cholera germs could endure for a month severe cold, ranging as low as −15° C., but that a tempera-

ture of –21° C. was fatal. Von Babes[69] succeeded in keeping a series of agar cultures of the vibrio alive, though exposed to the cold of a Berlin winter (1884–85) ranging as low as –14° C. In the year 1893 no less than eight papers were published dealing with the relation of the cholera germ to cold. Schruff[70] found that a broth culture made from fresh choleraic fæces was not sterilized by eight months' exposure to the winter's cold ranging as low as –12.5° C. Finkelnburg[71] noted that cultures of an old laboratory race were killed out in ten days, while cultures of fresher races were not.

Karschinski[72] stated that a cholera culture with which he worked was sterilized in four days by an average cold of –12.7° C. with a minimum of –17.6° C. Renk[73] froze the germs in sterilized river water at –5° C. to –7° C. and kept the flasks at that temperature, removing one each day for examination. Growth resulting from the melted ice was tested by cover-glass examination and by the Indol reaction. After five days' uninterrupted freezing the cholera germs disappeared, but when the period was broken by the melting of the contents of a flask for analysis and its re-freezing, a little longer period was necessary. When unsterilized river water was inoculated and frozen, the bacteria present fell off from 1,483,000 per centimeter to 62,445 in twenty-four hours, and to 4480 after three days. The cholera germs in this case could not be detected after seventy-two hours, and in one case not after thirty-nine hours. Uffelmann[74] found that cholera germs died out in five days at –15.5° C. and in three days at –24.8° C. Wnukow,[75] on the other hand, stated that gelatine stick cultures of the same microorganism were subjected for forty days to an outdoor temperature between –1° C. and –32° C. without sterilization. Double thawing and freezing also failed to destroy their power of growth. Montefusco[76] tested the pathogenicity of chilled cholera cultures for guinea pigs, and recorded that a temperature of –10° to –15° C. entirely destroyed their virulence in half an hour, while a temperature between 0° and –5° only weakened it. Cultivation at 37.5° soon restored the powers of the germs, but in the chilled and attenuated condition they produced a state of immunity in the animals injected. Abel[77] also mentions experiments in which cholera vibrios frozen in bouillon died out completely in from three to eight days. Kasansky,[78] in 1894, found that cholera cultures withstood for four months the winter's cold at Kasan, where the temperature fell to –31.8° C. One culture gave growth after twenty days of freezing. Some were thawed and refrozen as many as twelve times. After longer exposure, for five months, the cultures gave no growth. Kasansky demonstrated nearly as great a resistance to cold in the case of the vibrios of Finkler-Prior, Miller, Deneke, and Metschnikoff. Finally, some light was thrown on the discordant results of previous observers by the work of Weiss,[79] who inoculated tubes of broth and water from

the Spree with cholera cultures and froze them, thawing, sampling, and refreezing the tubes daily. In broth the germs persisted for twenty-one days, but in river water only for five days, the addition of a little broth to the water prolonging the time to eight days. Fresh intestinal contents of a cholera patient showed no vibrios after two or three freezings.[1]

From this long series of experiments it is evident that sterilization of rich cultures of bacteria cannot always be secured by the action of even very extreme cold. Hence the conclusion was drawn that the freezing of water could not be trusted at all to remove its bacterial impurities. There are, however, two objections to this line of reasoning. In the first place, the effect of cold on germs suspended in water may differ materially from its action on similar organisms when in a richly nutrient medium. In the second place, even if sterilization does not result from freezing in cultures containing millions of bacteria, it is conceivable that such a large proportion of the microbes may perish as to render very slender the chance of danger from ice formed under natural conditions. Experiments have shown that easily detected germs like B. prodigiosus can pass through a sand filter when applied to the surface in large numbers under certain conditions; yet a sand filter, in practice, is regarded as an efficient protection. A quantitative determination of the percentage reduction actually effected by freezing is required before drawing conclusions as to the sanitary significance of ice-supply in relation to the public health.

D. QUANTITATIVE STUDIES UPON THE DESTRUCTION OF BACTERIA BY FREEZING AND OTHER LOW TEMPERATURES.

The quantitative studies of Frankland [(58)] on B. anthracis, of Renk [(73)] on river-water bacteria, and of Christomonas,[(24)] on artificial ice, have already been mentioned. Work on the disappearance of bacteria in the freezing of natural water had, however, been undertaken at a much earlier period. Pengra,[(80)] in 1884, made an actual microscopic count of the organisms present, working with bacteria (species not stated), and other micro-organisms from decomposing meat juice, infusion of hay, and stagnant pools. His freezing was done by the winter's cold, and his figures were obtained by counting the contents of ten drops and taking an average. He found

[1] Macfadyen (Lancet, I, 1900, p. 849) has recently exposed cultures of Bacillus typhi, Bacillus coli communis, Bacillus diphtheriæ, Spirillum choleræ asiaticæ, Bacillus proteus vulgaris, Bacillus acidi lactici, Bacillus anthracis (spore bearing), Staphylococcus pyogenes aureus, Bacillus phosphorescens, and Photobacterium balticum in solid and liquid cultures to the temperature of liquid air (−182° C. to −190° C.), for twenty hours without sterilization and without impairing the properties of the organisms in any degree.

Macfadyen and Rowland (Lancet, Vol. I, 1900, p. 1130) treated the same organisms in broth emulsions in fine quill tubes with liquid air for seven days with the same results, except that a slightly delayed growth was noticed in some instances.

in the upper part of the ice 16 bacteria; in the lower part, only partially frozen, 250; in the upper and lower parts of a duplicate unfrozen vessel of water, 160 and 170, respectively. He obtained similar results with three species of Infusoria, and concluded that 90 per cent of the organisms were removed by freezing. His experiments appear, however, to show crystallization effects principally. The first careful work on this subject was done by Fraenkel in Berlin.(81) He collected river water, and after planting samples, froze them artificially at –8° to –12° C., thawing after different periods. In two days 83 per cent of the water bacteria present were killed; in three days 99 per cent; in five days, 90 per cent; in six days, 80 per cent; in six days, in another case, 93 per cent; and in nine days, 99 per cent. The different samples evidently varied greatly. Fraenkel also analyzed the regular Berlin ice-supply, and got results ranging from 21 to 9700 bacteria per cubic centimeter. He concluded that the ice was highly polluted and should not be taken into the system. About the same time Wolffhuegel and Riedel (82) gave an account of some experiments in which flasks of tap-water were kept in the ice-chest without freezing, and showed the following reductions: after one day, from 148 germs per cubic centimeter to 126 and from 150 to 115; after two days, from 123 to 69 and from 158 to 101; after three days, from 123 to 29 and from 156 to 33.

In 1887 Dr. Prudden of New York published the most exhaustive review hitherto attempted of the subject of quantitative reduction, and the first in which specific pathogenic germs were used.(83) His tubes, in the experiments with the latter organisms, were inoculated from pure cultures and frozen at –10° to –1° C., and his results were as follows, the numbers in each case referring to bacteria per cubic centimeter: —

B. prodigiosus. In water, 6300; in ice after 4 days, 2970; after 37 days, 22; after 51 days, 0.

Proteus vulgaris. In water, 8320; in ice after 18 days, 88; 51 days, 0.

Staphylococcus pyogenes aureus. In water, innumerable; in ice after 18 days, 224,598; 20 days, 46,486; 54 days, 34,320; 66 days, 49,280.

Species unnamed. In water, innumerable; in ice after 4 days, 571,450; 11 days, 520,520; 51 days, 183,040; 65 days, 10,978; 77 days, 85,008.

Species unnamed. In water, 800,000; in ice after 7 days, 0.

B. typhi. In water, innumerable; in ice after 11 days, 1,019,403; 27 days, 336,457; 42 days, 89,796; 69 days, 24,276; 77 days, 72,930; 103 days, 7348.

Same. In water, 378,000; in ice after 12 hours, 164,780; after 3 days, 236,676; 5 days, 21,416; 8 days, 76,032.

Dr. Prudden then made certain experiments to determine the effect of alternate

freezing and thawing, and obtained the following results. The tubes were here immersed in ice and salt at –20° C.

B. TYPHI.

In water . . .	40,896		
Frozen 24 hours	29,780	Refrozen 3 times	90
" 3 days	1,800	" 5 "	0
" 4 "	950	" 6 "	0
" 5 "	2,490	" 6 "	0

B. PRODIGIOSUS.

In water . . .	339,516		
Frozen 24 hours	36,410	Refrozen once	2,570
" 30 "	41,580	" 2 times	275
" 48 "	14,440	" 3 "	15
" 96 "	4,850	" 4 "	0

STAPHYLOCOCCUS PYOGENES AUREUS.

In water . . .	111,782		
Frozen 15 minutes	52,500		
" 2 hours	21,300		
" 24 "	22,690	Refrozen once	13,495
" 48 "	6,460	" 3 times	110
" 96 "	6,155	" 4 "	0

Dr. Prudden found that, with fresh, active agar cultures of this staphylococcus 49,280 germs remained alive, out of innumerable germs originally present, after sixty days; when cultures from old and dried agar were used, 162,000 germs disappeared entirely after five days. He ultimately drew the following conclusions from these experiments with pathogenic germs: 1. Many bacteria are killed by freezing. 2. The vitality of the original culture affects the number so killed. 3. The number killed varies with the species. 4. The number killed increases as the time of freezing is prolonged. 5. The resistance to cold varies with the individual bacterium. 6. Alternate freezing and thawing is very generally fatal.

Dr. Prudden also froze natural waters with their native bacteria for varying periods, and obtained somewhat similar results. He analyzed 270 samples of New York ice, and found an average of 2033 bacteria per cubic centimeter. The numbers were highest in the upper layers of snow ice and bubbly ice, and in ice cut in the immediate vicinity of Albany, falling off rapidly in ice five or six miles down the river. He concluded that this highly polluted ice probably contained the germs of typhoid fever and should not be taken into the human body.

Later in the same year Bordoni-Uffreduzzi [84] published a paper in which he took issue with Prudden on several points. He contended that the changes of temperature in the latter's experiments were too abrupt, that the resistance of the germs worked with had been weakened by cultivation on artificial media, and that the effect had been abnormally severe on account of the small size of the tubes frozen. He himself analyzed the natural water in one of the municipal basins of Berlin, just before a frost, and then kept a large lump of the ice in a double-walled zinc chest, breaking off samples for analysis every month. He found that about 90 per cent of the bacteria were killed, and thought the duration of the freezing did not make any material difference. His results, of course, varied very widely on account of the unequal distribution of the bacteria in the ice.

Russell [85] a little later made similar experiments at Madison, Wisconsin, in which he found that the ice formed on Lake Mendota contained about 40 per cent of the germs present in the water itself. A report already cited [21] was made by the State Board of Health of Massachusetts in 1889 in which ice from fifty-eight sources was analyzed in comparison with the water on which it had formed. Averaging all results, there were 81 per cent as many bacteria present in the snow ice as in the water, 10 per cent in all the rest of the ice, and only 2 per cent in the clear ice. In the report of the Board for the next year,[86] Mr. Hiram F. Mills noted an isolated but significant experiment in which sterilized tap water was inoculated with the typhoid germ, kept in a bottle surrounded by ice and sampled at intervals. The results were as follows: —

Day	Number of Typhoid Bacilli.	Day	Number of Typhoid Bacilli.
1	6120	15	100
5	3100	20	17
10	490	25	0

Taken altogether, more exact studies confirm the rough estimate of Pengra that some 90 per cent of ordinary water bacteria are eliminated by the process of freezing. As to the percentage reduction of specific pathogenes and, in particular, of the typhoid bacillus, probably the only form of great practical importance, the evidence is very meagre. The only results hitherto, as far as we have been able to discover, which fix quantitatively the effect of cold on this organism, are the three experiments of Dr. Prudden and the single experiment of the biologists of the Massachusetts State Board of Health. These certainly appear to form a slender basis for conclusions relative to the importance of ice-supply as a possible source of typhoid fever.

III. EXPERIMENTS BY THE AUTHORS ON THE EFFECT OF COLD UPON THE BACILLI OF TYPHOID FEVER.

A. EXPERIMENTS ON THE PERCENTAGE REDUCTION OF TYPHOID FEVER BACILLI EFFECTED BY FREEZING FOR DIFFERENT PERIODS OF TIME.

METHODS EMPLOYED.

The following investigation was undertaken in order to so extend and amplify the work of Prudden as to obtain some idea of the average fatality occurring among typhoid bacilli in ice, and of the special conditions which affect such fatality. Pure cultures alone were used, as it is obvious that figures, to be of much value, must be determined separately for each specific germ. Great pains were taken to preserve, as far as possible, the vigor of the culture used, and new cultures from recent post-mortem examinations were obtained at intervals during the work. Finally, a large number of determinations were made for each set of conditions, in order to obtain average results free from the errors which may beset any individual case.

Our experiments on the percentage reduction effected by freezing were carried on by freezing small tubes of infected water, as only in this way can the conditions of the experiment be rigidly controlled. Ordinary test-tubes, containing about 10 cubic centimeters of sterilized tap water, were inoculated from a two or three day bouillon culture, and duplicate samples were at once planted. The ten tubes of the set under experiment were then placed in a double-walled tin vessel in which they were to be frozen. The inner vessel was a cylinder about 8 inches deep, nearly filled with a mixture of equal parts of glycerine and 95 per cent alcohol; in this solution the tubes were immersed, being supported by a disc perforated with holes to receive them. The solution served to make the lowering of temperature equal and gradual, and also acted as an antiseptic when the tubes broke, which sometimes happened when they contained too much water, or when the temperature went down too rapidly. In the outer vessel, which was jacketed with felt, was placed cracked ice which reduced the temperature of the glycerine-alcohol mixture to about 10°–15° C. in from an hour to an hour and a half. The ice was then replaced by a mixture of ice and salt which completed the freezing

in a half or three-quarters of an hour more. The time occupied by the whole process of freezing is recorded in the tabulation of each experiment. The temperature, in the first set of experiments with "Race A," was observed by means of three mercury thermometers inserted in different parts of the liquid, and at the time when the tubes froze the thermometers registered 6°–7° below zero, C. In later experiments the temperature was observed by means of a minimum registering spirit thermometer fastened to the inside of the cover of the inner cylinder, which recorded the temperature of the air just above the liquid in which the tubes were immersed. Partly on this account and probably partly because of its greater quickness of response, this thermometer gave lower records than did the mercury instruments in the first experiments. The readings of the spirit thermometer are given in the tables for each set of tubes.

As soon as the tubes froze, they were removed from the freezer and either thawed at once or kept frozen in an ice-chest for a few hours, or placed in a cold-storage warehouse where they were kept for the longer periods at a temperature one or two degrees below zero, C. After the frozen condition had been maintained for the desired length of time, the contents of the tubes were thawed, shaken up, and sampled, again in duplicate. As a rule the samples taken from the thawed tubes were planted directly, while those made before freezing were diluted, one to ten, with sterilized water. All plates, for these quantitative determinations, were planted with common nutrient agar-agar, containing 1.25 per cent agar, 1.00 per cent Witte's peptone, and .25 per cent salt, and having an acidity equal to 1.50 per cent. As the counts to be made were chiefly comparative, agar was preferred to any other medium, on account of its freedom from liquefaction. The plates were allowed to develop at the room temperature except in certain special cases to be noted later. Those made from the unfrozen water showed their maximum growth in three days and were counted after that interval. Those made from the thawed ice, however, were found to develop more slowly; for them five days was generally found sufficient, although after the longer periods of freezing as much as ten days was sometimes allowed. The plates were finally counted with the aid of a hand lens.

In many of the sets of experiments a control tube was included, which was treated just like the others except that it was not inoculated. Each series of tubes includes two lots of eight or ten each, frozen on two different days.

The cultures were grown in bouillon (containing 1.00 per cent peptone, .25 per cent salt, and 1.00 per cent acid), and were changed twice or three times a week. In the earlier experiments the tubes were inoculated from a culture grown at the room

temperature, itself inoculated from one grown at 37.5 C. In the later work the cultures were all kept at the room temperature.

When experiments made on the culture obtained in November, 1898, gave results somewhat different from those given by the culture used in February, it was decided that still a third culture from a different source must be compared with the first two. The results showed that the descendants of these different stocks exhibited slight though constant and persistent differences in their reaction to cold. We have called the cultures derived from these original sources "Races," for physiological races they apparently must be considered.

The first culture used, Race A, was obtained from the Boston City Hospital as a forty-hour-old blood-serum culture on February 23, 1898. Unfortunately, the history and tests applied to this culture in the Hospital were not recorded, beyond the fact that it had been isolated from an autopsy about two weeks previously, by the usual differential methods.

Race B was obtained by the kindness of Dr. M. W. Richardson of the Massachusetts General Hospital in the middle of November, 1898, with the following history. It had been isolated from the spinal canal, in a case of typhoid meningitis. It gave typical reactions in media as follows: bouillon, very motile; litmus milk, no coagulum, slight acid production; sugar-agar, no gas; peptone solution, no indol; gelatine slant stab, typical growth, no liquefaction; arsenic bouillon (Thoinot), no growth; Capaldi-Proskauer sol. No. 1, no growth; potato, no visible growth; tube medium of His, clouding without gas production; typhoid serum, perfect reaction.

Race C was obtained, January 14, 1899, by the courtesy of Dr. Pratt of the Boston City Hospital. It had been isolated, December 30, from the peritoneal cavity in a case of peritonitis following typhoid fever. It gave typical growths on the ordinary media, gelatine, bouillon, and glycerin-agar; it was motile in the hanging drop; it gave no indol and no gas in glucose solution; it was decolorized by the Gram method and reacted to typhoid serum.

Race D was isolated in the laboratory of the City Hospital, March 26, 1899, from the urethra. It was identified by the same tests used for Race C.

Results Obtained.

The percentage reductions recorded in the subjoined tables (pp. 492–498), summarized in final form, are as follows: —

PERCENTAGE REDUCTION OBSERVED IN EXPERIMENTS ON THE VIABILITY OF TYPHOID BACILLI IN ICE.

	Race A.	B.	C.	D.
Frozen 15 minutes	59.4	13.8		
" 30 "	63.7			
" 1½ hours		32.2		
" 2 "	73.6			
" 3 "		41.4	99.5	74.8
" 6 "	77.8			97.0
" 12 "		38.6		84.4
" 15 "			98.0	
" 24 "		53.8	82.7	99.0
" 3 days		98.4	99.9	
" 7 "		93.3	99.5	
" 2 weeks	99.8	99.4	99.9	
" 4 "	99.8			
" 8 "	99.8			
" 12 "	99.8			

Conclusions.

1. Evidently we may reaffirm for the bacillus of typhoid fever the first of Prudden's conclusions as to the various pathogenes with which he worked, namely, that many bacteria are killed by freezing. After two weeks' exposure to the freezing temperature an average of considerably over 99 per cent of the germs perished. Of the 140 tubes inoculated with Races A, B, and C, and frozen for periods of two weeks and over, all but nine showed a reduction of over 99 per cent; and of the nine, all but one showed a reduction of 98 per cent or over. We may safely conclude that less than 1 per cent of the typhoid germs present in water can survive fourteen days of freezing.

2. During the first half-hour of freezing a heavy reduction takes place, amounting, perhaps, to 50 per cent. The tubes exposed for such short times to the unfavorable conditions exhibit a remarkable variability among themselves. In the same set one tube may show no reduction, while its neighbor is rendered almost sterile. Whether these differences are due to the varying physical conditions in the individual tubes, or to variations in the biological character of the loopful of bacteria used for inoculation, is uncertain. From the general harmony of the results obtained it appears that this factor of variability, whatever it may be, is practically eliminated by the averaging of 20 tubes.

After this brief period of sudden but uncertain reduction, the destruction of the germs proceeds pretty regularly as a function of the time. Although the different races vary, there is in each race a steadily increased reduction, with slight variations, as the time of freezing is prolonged. After 14 days, even with the most resistant

stock, Race B, the reduction was over 99 per cent. The reduction now proceeds, however, with increasing slowness; the two or three germs per thousand which have survived thus far appear to possess special powers of resistance. Even after 12 weeks few of the individual tubes were rendered sterile. These results appeared so remarkable that special experiments were conducted to test their accuracy, as it was felt that perhaps the few germs developing from the thawed ice might have been introduced from the air, as was obviously the case in some instances. Fifty tubes of Races B and C were therefore frozen for periods of a week and a month; plates were planted from them, with special precautions, and incubated at 37.5; and the developing colonies were examined individually. The results, as the appended tables show (see p. 492), confirm those of the general investigation. Of the 20 tubes inoculated with Race B and frozen for a month, 10 were sterile; 9 gave one sterile plate, and one with one or two colonies of what proved to be extraneous germs; tube IV. alone gave, on one plate, 7 germs per cubic centimeter, which examination in the hanging drop, and growth on gelatine, and potato, in milk and glucose solution, showed to be the original typhoid culture. So of the 30 tubes of Race C frozen for a week, 17 were sterile; 9 showed contamination, one or two germs per plate; the other four showed 15, 4, 1, and 267 typhoid bacilli per cubic centimeter. These experiments confirm the results of those observers who froze typhoid cultures containing millions of germs without effecting sterilization.

3. Prudden's statement that the number of bacteria killed by freezing varies with the species may be extended. It is evident that within the species B. typhi abdominalis there are races, each having a power of resistance of its own, dependent upon its history within and without the body. A comparison of the tables for the shorter periods of freezing shows clearly that Race C succumbed with much greater readiness to the influence of cold than did Race B; while Races A and D occupied an intermediate position. These differences appear constant through the various sets, so that in each race the progressively increased reduction with more prolonged freezing follows a parallel course. The facts cannot, we think, be attributed to differences in the immediate environment of the germs; such differences do produce their effect, cultivation for a time on agar, for example, causing a decrease in resistance. The last sort of change is, however, temporary and may be quickly reversed by cultivation in bouillon; while the race differences were permanent during the period of experimentation. Correlated with them were certain minor characters; for instance, the weakest race, Race C, grew more slowly than either of the others, and took perceptibly longer to produce a definite clouding in a liquid medium.

RACE A. SERIES I.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
1	8750	21	99.8
2	910	4	99.5
3	4910	1	99.9+
4	1465	1	99.9
5	900	–	—
6	2475	4	99.8
7	1260	3	99.8
8	1360	10	99.2
9	1535	1	99.9+
10	1030	7	99.3
11	35210	0	100.0
12	22575	3	99.9+
13	53060	1	99.9+
14	8575	–	—
15	94580	–	—
16	116235	1	99.9+
17	140175	–	—
18	95725	4	99.9+
19	4602	3	99.9
20	229950	2	99.9+
Average			99.8

Tubes **1–10**, frozen March 2, 1898, in $1\frac{1}{2}$ hours; thawed May 25, after *12 weeks*.
Tubes **11–20**, frozen March 4, 1898, in 2 hours; thawed May 27, after *12 weeks*.

RACE A. SERIES II.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
21	10655	17	99.8
22	7695	42	99.4
23	3170	2	99.9
24	4265	2	99.9
25	90825	1	99.9+
26	79625	2	99.9+
27	5920	6	99.9
28	275	1	99.6
29	5400	1	99.9+
30	2085	3	99.9
31	11480	2	99.9+
32	24637	12	99.9
33	214200	9	99.9+
34	2760	7	99.7
35	10430	113	98.9
36	32110	4	99.9+
37	12757	7	99.9
38	26547	4	99.9+
39	15155	8	99.9
40	19890	1	99.9+
Average			99.8

Tubes **21–30**, frozen March 7, 1898, in $2\frac{1}{2}$ hours; thawed May 2, after *8 weeks*.
Tubes **31–40**, frozen March 12, 1898, in $2\frac{1}{4}$ hours; thawed May 7, after *8 weeks*.

RACE A. SERIES III.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
41	3730	6	99.8
42	7880	5	99.9
43	2810	6	99.8
44	710	7	99.0
45	4470	4	99.9
46	9626	3	99.9+
47	10482	2	99.9+
48	3035	12	99.6
49	2085	11	99.5
50	5710	5	99.9
61	136710	5	99.9+
62	41230	3	99.9+
63	82215	1	99.9+
64	26285	5	99.9
65	22225	1	99.9+
66	19145	3	99.9+
67	Control	Control	—
68	12320	2	99.9+
69	10850	4	99.9+
70	10920	3	99.9+
Average			99.8

Tubes **41–50**, frozen March 16, 1898, in 2 hours; thawed April 13, after *4 weeks*.
Tubes **61–70**, frozen March 19, 1898, in $1\frac{1}{2}$ hours; thawed April 16, after *4 weeks*.

RACE A. SERIES IV.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
51	24640	25	99.9
52	49000	10	99.9+
53	48930	30	99.9
54	40450	60	99.8
55	29340	30	99.9
56	282240	65	99.9+
57	44380	110	99.7
58	132300	50	99.9+
59	24185	25	99.9
60	93555	75	99.9
71	55650	–	—
72	Control	Control	—
73	52395	35	99.9
74	9230	70	99.2
75	86870	60	99.9
76	46025	25	99.9
77	1740	25	98.6
78	41825	5	99.9+
79	33155	35	99.9
80	23250	30	99.9
Average			99.8

Tubes **51–60**, frozen March 18, 1898, in $1\frac{1}{4}$ hours; thawed April 1, after *2 weeks*.
Tubes **71–80**, frozen March 21, 1898, in $2\frac{1}{2}$ hours; thawed April 4, after *2 weeks*.

RACE A. SERIES V.

Number of Tube.	Average Number Bacteria per c.c		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
171	628425	48090	92.3
172	5355	2040	61.9
173	520380	8610	98.3
174	355950	122535	65.6
175	354690	36540	89.7
176	206010	19775	90.4
177	474390	4000	99.0
178	402020	—	—
191	3365	15	99.5
192	3300	40	98.8
193	103320	30	99.9+
194	133875	275	99.8
195	348655	315315	9.6
196	40	70	0.0
197	214200	350	99.8
198	169155	64575	61.8
Average			77.8

Tubes **171–178**, frozen May 9, 1898, in 2 hours; thawed same day, after *6 hours.*

Tubes **191–198**, frozen May 13, 1898, in $2\frac{1}{3}$ hours; thawed same day, after *6 hours.*

RACE A. SERIES VI.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
151	40775	21980	46.1
152	39235	17080	56.5
153	45465	14770	67.5
154	26530	15190	42.7
155	36295	14385	60.4
156	10710	5110	52.3
157	23520	3800	83.8
158	127260	40005	68.6
181	300	15	95.0
182	51030	9660	81.1
183	13265	1410	89.4
184	20475	2955	85.6
185	14595	1145	92.2
186	23415	805	96.6
187	22365	2915	87.0
188	2260	—	—
Average			73.6

Tubes **151–158**, frozen April 30, 1898, in $2\frac{1}{4}$ hours; thawed, same day, after *2 hours.*

Tubes **181–188**, frozen May 11, 1898, in $2\frac{1}{4}$ hours; thawed same day, after *2 hours.*

RACE A. SERIES VII.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
81	1820	990	45.9
82	2795	40	98.6
83	1265	25	98.1
84	820	0	100.0
85	355	15	95.8
86	430	15	96.5
87	2515	2075	17.5
88	1285	0	100.0
89	755	10	98.7
90	165	5	97.0
101	25970	11340	56.3
102	11665	8015	31.3
103	16955	4555	73.1
104	30730	26355	14.2
105	Control	Control	—
106	8750	6510	25.6
107	9205	5525	40.0
108	9345	3380	63.8
109	20090	11410	43.2
110	14315	9170	35.9
Average			63.7

Tubes **81–90**, frozen March 25, 1898, in $1\frac{2}{3}$ hours; thawed same day, after *30 minutes.*

Tubes **101–110**, frozen April 9, 1898, in 2 hours; thawed same day, after *30 minutes.*

RACE A. SERIES VIII.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
121	500220	715	99.9
122	492345	252640	48.7
123	57420	27755	51.7
124	53795	705	98.7
125	Control	Control	—
126	5705	955	83.2
127	124110	7175	94.2
128	77490	9800	87.3
161	33810	17640	47.9
162	276900	275940	.3
163	349020	120960	65.3
164	246645	111930	54.6
165	120775	62050	48.6
166	472500	236880	49.9
167	756550	505575	33.2
168	170100	123795	27.2
Average			59.4

Tubes **121–128**, frozen April 23, 1898, in $1\frac{1}{2}$ hours; thawed same day, after *15 minutes.*

Tubes **161–168**, frozen May 4, 1898, in $1\frac{1}{2}$ hours; thawed same day, after *15 minutes.*

RACE B. SERIES I.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
71	37275	462	98.8
72	45990	27	99.9
73	41685	189	99.5
74	63210	382	99.4
75	26250	773	97.1
76	34230	599	98.3
77	18800	378	98.0
78	40110	467	98.8
79	42525	613	98.6
80	50295	47	99.9
81	144325	23	99.9+
82	108360	11	99.9+
83	123165	8	99.9+
84	89775	7	99.9+
85	83790	9	99.9+
86	58275	10	99.9+
87	104895	21	99.9+
88	83475	11	99.9+
89	187110	51	99.9+
90	56595	15	99.9+
Average			99.4

Tubes **71–80**, frozen December 16, 1898, in $1\frac{1}{3}$ hours; thawed December 30, after *2 weeks*. Minimal temperature, (−14° C.).

Tubes **81–90**, frozen December 17, 1898 in 2 hours; thawed December 31, after *2 weeks*. Minimal temperature, (−8° C.).

RACE B. SERIES II.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
111	52605	3622	93.1
112	88200	1386	98.4
113	95235	4018	95.8
114	63065	1270	98.0
115	31080	1165	96.3
116	43470	1470	96.6
117	47040	896	98.1
118	37065	511	98.6
119	32890	441	98.7
120	54495	2935	94.6
121	10290	2373	76.9
122	54705	4106	92.5
123	69990	1466	97.9
124	21175	2993	85.9
125	45150	—	—
126	61005	4452	92.7
127	61950	3633	94.1
128	114030	17042	85.1
129	90090	8127	91.0
130	6650	805	87.9
Average			93.3

Tubes **111–120**, frozen December 23, 1898, in 2 hours; thawed December 30, after *1 week*. Minimal temperature, (−10° C.).

Tubes **121–130**, frozen December 24, 1898, in $1\frac{1}{2}$ hours; thawed December 31, after *1 week*. Minimal temperature, (−12° C.).

RACE B. SERIES III.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
91	34965	180	99.5
92	25445	55	99.8
93	28560	60	99.8
94	29085	165	99.4
95	33810	365	98.9
96	32745	25	99.9
97	26880	5705	78.8
98	15855	15	99.9
99	22330	75	99.7
100	90300	30	99.9+
151	2560	2	99.9
152	1595	4	99.7
153	1555	—	—
154	—	—	—
155	225	1	99.6
156	1195	4	99.6
157	95	2	97.9
158	80	1	98.8
159	30	0	100.0
160	25	0	100.0
Average			98.4

Tubes **91–100**, frozen December 20, 1898, in 2 hours; thawed December 23, after *3 days*. Minimal temperature, (−12° C.).

Tubes **151–160**, frozen January 3, 1899, in 2 hours; thawed January 6, after *3 days*. Minimal temperature, (−12° C.).

RACE B. SERIES IV.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
41	70560	38535	45.4
42	52290	31605	39.5
43	38640	28665	25.8
44	48405	10589	78.1
45	71505	14458	79.8
46	44100	10822	75.4
47	63945	21641	66.2
48	28245	13541	52.1
49	91035	19845	78.3
50	27300	11340	58.3
51	14140	5740	59.4
52	37800	25830	31.7
53	29925	15995	46.6
54	14280	5810	59.3
55	39710	16870	57.5
56	27825	9486	65.9
57	13685	5390	60.6
58	12565	5565	55.7
59	32760	33075	0.0
60	24570	9345	62.0
Average			53.8

Tubes **41–50**, frozen December 1, 1898, in 2 hours; thawed December 2, after *24 hours*. Minimal temperature, (−7° C.).

Tubes **51–60**, frozen December 8, 1898, in $2\frac{1}{4}$ hours; thawed December 9, after *24 hours*. Minimal temperature, (−10° C.).

RACE B. SERIES V.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
61	30135	13510	55.2
62	23625	8505	64.0
63	19635	10430	46.9
64	13055	12600	3.4
65	21840	10500	51.9
66	13685	6720	50.9
67	16800	10535	37.3
68	12075	8435	30.1
69	13230	11130	15.9
70	18025	12740	29.3
101	32865	18515	43.7
102	31710	37275	0.0
103	42525	5670	86.7
104	32865	36225	0.0
105	4585	65	98.5
106	22050	9380	57.5
107	5280	184590	0.0
108	5267	206010	0.0
109	15155	0	100.0
110	4585	107740	0.0
Average			38.6

Tubes **61–70**, frozen December 9, 1898, in 2¾ hours; thawed December 10, after *12 hours.* Minimal temperature, (–6° C.).

Tubes **101–110**, frozen December 21, 1898, in 1½ hours; thawed December 22, after *12 hours.* Minimal temperature, (–8° C.).

RACE B. SERIES VI.

Number of Tube.	Average number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
21	10	200	0.0
22	75	170	0.0
23	190	70	63.2
24	2695	3360	0.0
25	100	250	0.0
26	210	375	0.0
27	1605	1505	6.2
28	180	350	0.0
29	1875	1825	2.7
30	3400	620	81.8
31	22905	12040	47.4
32	32655	8295	74.6
33	18550	6300	66.1
34	22225	6125	72.4
35	13755	4165	69.7
36	15575	3972	74.5
37	15750	7490	52.4
38	15470	3920	74.7
39	19215	5705	70.3
40	9590	2610	72.8
Average			41.4

Tubes **21–30**, frozen November 28, 1898, in 1½ hours; thawed same day, after *3 hours.* Minimal temperature, (–8° C.).

Tubes **31–40**, frozen November 29, 1898, in 1½ hours; thawed same day, after *3 hours.* Minimal temperature, (–8° C.).

RACE B. SERIES VII.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
1	3515	2080	40.8
2	2180	3000	0.0
3	3535	2620	25.9
4	4455	3105	30.3
5	Control	Control	—
6	4300	4325	0.0
7	4975	3525	29.1
8	3405	3160	0.0
9	4305	5970	0.0
10	4615	3225	30.1
11	7960	6300	20.8
12	16380	14490	11.5
13	7560	6860	9.2
14	19460	21560	0.0
15	12215	10080	17.5
16	21700	15085	30.5
17	7665	8400	0.0
18	13300	11060	16.8
19	10920	11340	0.0
20	10360	14770	0.0
Average			13.8

Tubes **1–10**, frozen November 19, 1898, in 2¼ hours; thawed, same day, after *15 minutes.*

Tubes **11–20**, frozen November 21, 1898, in 1¼ hours; thawed, same day, after *15 minutes.*

RACE C. SERIES I.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
1	6580	–	—
2	13475	5	99.9+
3	4795	7	99.9
4	9310	4	99.9+
5	10005	5	99.9+
6	10885	2	99.9+
7	6230	102	98.4
8	5215	0	100.0
9	10325	–	—
10	11550	6	99.9+
21	120645	12	99.9+
22	142065	16	99.9+
23	16695	0	100.0
24	0	0	—
25	0	1	—
26	13755	12	99.9
27	378945	1	99.9+
28	101115	0	100.0
29	4370	2	99.9+
30	128520	88	99.9
Average			99.9

Tubes **1–10**, frozen January 16, 1899, in 1¾ hours; thawed January 30, after *2 weeks.* Minimal temperature, (–13° C.).

Tubes **21–30**, frozen January 18, 1899, in 1¾ hours; thawed February 1, after *2 weeks.* Minimal temperature (–10° C.).

RACE C. SERIES II.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water	Thawed Ice.	
51	1920	2	99.9
52	2675	2	99.9
53	2200	1	99.9+
54	2510	3	99.9
55	2065	33	98.4
56	1605	10	99.4
57	1685	1	99.1
58	835	13	98.4
59	460	15	96.7
60	1820	–	—
71	6580	0	100.0
72	7700	10	99.9
73	2485	1	99.9+
74	6440	1	99.9+
75	5145	3	99.9
76	4130	1	99.9+
77	3920	1	99.9+
78	3080	4	99.9
79	3535	0	100.0
80	540	0	100.0
Average			99.5

Tubes **51–60**, frozen January 23, 1899, in $1\frac{1}{2}$ hours; thawed January 30, after *1 week*. Minimal temperature, (−12° C.).

Tubes **71–80**, frozen January 25, 1899, in $1\frac{1}{2}$ hours; thawed February 1, after *1 week*. Minimal temperature, (−14° C.).

RACE C. SERIES III.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
11	16765	9	99.9
12	17220	0	100.0
13	14315	2	99.9+
14	900	2	99.8
15	18270	3	99.9+
16	9170	1	99.9+
17	6930	0	100.0
18	7385	0	100.0
19	2925	0	100.0
20	9555	1	99.9+
41	83475	6	99.9+
42	83160	5	99.9+
43	64890	2	99.9+
44	66570	4	99.9+
45	11200	1	99.9+
46	21350	23	99.9
47	2030	3	99.9
48	700	1	99.9
49	185	2	98.9
50	1625	2	99.9
Average			99.9

Tubes **11–20**, frozen January 17, 1899, in $1\frac{1}{3}$ hours; thawed January 20, after *3 days*. Minimal temperature, (−13° C.).

Tubes **41–50**, frozen January 20, in 2 hours; thawed January 23, after *3 days*. Minimal temperature, (−10° C.)

RACE C. SERIES IV.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
61	3335	5	99.9
62	3520	25	99.3
63	195	10	94.9
64	885	55	93.8
65	235	25	89.4
66	215	60	72.1
67	2105	10	99.5
68	555	20	96.4
69	40	20	50.0
70	500	15	97.0
81	1855	85	95.4
82	1830	20	98.9
83	260	55	78.8
84	935	35	96.3
85	110	95	13.6
86	3595	30	99.2
87	4480	35	99.2
88	315	70	77.8
89	50	40	20.0
90	0	40	—
Average			82.7

Tubes **61–70**, frozen January 24, 1899, in $1\frac{1}{3}$ hours; thawed January 25, after *24 hours*. Minimal temperature, (−12° C.).

Tubes **81–90**, frozen January 26, 1899, in $1\frac{1}{2}$ hours; thawed January 27, after *24 hours*. Minimal temperature, (−13° C.).

RACE C. SERIES V.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
91	10710	20	99.8
92	7280	75	99.0
93	9555	90	99.1
94	4645	5	99.9
95	7735	35	99.5
96	1570	355	77.4
97	1325	20	98.5
98	—	—	—
99	6440	590	90.8
100	13090	10	99.9
111	143640	5	99.9+
112	234360	105	99.9+
113	105525	10	99.9+
114	41265	135	99.7
115	11655	5	99.9+
116	36855	20	99.9
117	27195	40	99.9
118	119070	50	99.9+
119	45360	5	99.9+
120	15855	—	—
Average			98.0

Tubes **91–100**, frozen January 27, 1899, in 2 hours; thawed January 28, after *15 hours*. Minimal temperature, (−14° C.).

Tubes **111–120**, frozen February 3, 1899, in 2 hours; thawed February 4, after *15 hours*. Minimal temperature, (−15° C.).

RACE C. SERIES VI.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
31	350	10	97.1
32	270	0	100.0
33	185	0	100.0
34	90	5	94.5
35	5	0	100.0
36	0	–	—
37	5	0	100.0
38	20	0	100.0
39	5	0	100.0
40	0	0	—
101	172080	1	99.9+
102	61110	9	99.9+
103	56700	1	99.9+
104	40005	4	99.9+
105	16660	0	100.0
106	146475	1	99.9+
107	8855	1	99.9+
108	9345	12	99.9
109	6930	2	99.9+
110	5075	0	100.0
Average			99.5

Tubes **31–40**, frozen January 19, 1899, in 2 hours; thawed same day, after *3 hours*. Minimal temperature, (–8° C.).

Tubes **101–110**, frozen February 2, 1899, in 2 hours; thawed same day, after *3 hours*.

RACE D. SERIES I.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
1	5355	3080	42.5
2	5915	3265	44.8
3	6090	2465	59.5
4	5670	670	88.2
5	3010	1615	46.3
6	4410	780	82.3
7	3745	365	90.3
8	3290	1000	69.6
9	4375	480	89.0
10	6580	3640	44.7
11	—	—	—
12	2380	95	96.0
13	—	—	—
14	—	—	—
15	7210	65	99.1
16	1855	40	97.8
17	3675	90	97.5
18	—	—	—
19	—	—	—
20	—	—	—
Average			74.8

Tubes **1–10**, frozen April 27, 1899, in 2 hours: thawed same day, after *3 hours*. Minimal temperature, (–16° C.).

Tubes **11–20**, frozen April 28, 1899, in 2 hours; thawed same day, after *3 hours*. Minimal temperature, (–14° C.).

RACE D. SERIES II.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice	
31	52605	318	99.4
32	53235	5072	90.5
33	77175	52	99.9
34	5565	927	83.3
35	184275	7339	96.0
36	6580	420	93.6
37	1890	—	—
38	62055	6457	89.6
39	3255	87	97.3
40	6020	134	97.8
71	24360	2	99.9+
72	29505	2	99.9+
73	8925	22	99.8
74	2430	0	100.0
75	12810	4	99.9+
76	24355	3	99.9+
77	9450	210	97.8
78	2065	1	99.9+
79	3160	1	99.9+
80	2185	1	99.9+
Average			97.0

Tubes **31–40**, frozen May 1, 1899, in 2 hours; thawed same day, after *6 hours*. Minimal temperature, (–10° C.).

Tubes **71–80**, frozen May 8, 1899, in 2 hours; thawed same day, after *6 hours*. Minimal temperature, (–16° C.)

RACE D. SERIES III.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
21	3990	15	99.6
22	3675	20	99.5
23	670	15	97.8
24	180	100	44.4
25	595	45	92.4
26	2275	15	99.3
27	180	20	88.9
28	140	25	83.6
29	25	25	0.0
30	240	0	100.0
41	515	33	93.6
42	1575	152	90.3
43	495	39	92.2
44	—	—	—
45	1855	88	95.3
46	2625	409	84.4
47	—	—	—
48	—	—	—
49	7175	511	92.9
50	1025	192	81.3
Average			84.4

Tubes **21–30**, frozen April 28, 1899, in 2 hours: thawed April 29, after *12 hours*. Minimal temperature, (–11° C.).

Tubes **41–50**, frozen May 1, 1899, in 2 hours; thawed May 2, after *12 hours*. Minimal temperature, (–10° C.).

Race D. Series IV.

Number of Tube.	Average Number Bacteria per c.c. Unfrozen Water.	Average Number Bacteria per c.c. Thawed Ice.	Reduction per cent.
51	33915	—	—
52	24570	106	99.6
53	60795	33	99.9
54	15960	35	99.8
55	24805	89	99.6
56	8820	103	98.8
57	6860	6	99.9
58	8960	55	99.4
59	2660	29	98.9
60	130410	199	99.8
61	21735	32	99.9
62	3200	71	97.8
63	5215	5	99.9
64	6160	63	99.0
65	955	10	99.0
66	2085	40	98.1
67	10885	65	99.4
68	250	3	98.8
69	790	34	95.7
70	1150	23	98.0
Average			99.0

Tubes **51–60**, frozen May 2, 1899, in 2 hours; thawed May 3, after *24 hours*. Minimal temperature, (–13° C.).
Tubes **61–70**, frozen May 3, in 2 hours; thawed May 4, after *24 hours*. Minimal temperature, (–12° C).

Race B. Special Series.

Number of Tube.	Number Colonies per c.c. Unfrozen Water.		Number Colonies per c.c. Thawed Ice.		
I	56070	83790	0	0	
II	55440	53550	0	0	
III	62370	61110	1	0	
IV	19320	21210	0	7	*
V	42210	29190	0	0	
VI	28980	30030	0	0	
VII	28770	18060	1	0	
VIII	23730	33390	0	1	
IX	46410	42630	1	2	
X	—	7420	0	1	
XI	13720	12180	0	0	
XII	22050	28980	1	0	
XIII	11830	7700	0	0	
XIV	7980	7560	0	0	
XV	7070	6020	1	0	
XVI	6020	4690	0	0	
XVII	5810	4690	0	0	
XVIII	1840	1850	0	1	
XIX	1260	1510	1	0	
XX	3430	4200	0	0	

Tubes **I–X**, frozen February 10, 1899, in 4 hours; thawed March 10, after *4 weeks*. Minimal temperature, (–10° C.).
Tubes **XI–XX**, frozen February 15, in $1\frac{1}{2}$ hours; thawed March 15, after *4 weeks*. Minimal temperature, (–10° C.).

* Colonies in ice of Tube IV proved to be typhoid. Colonies in ice in tubes not starred proved to be contaminations.

Race C. Special Series.

Number of Tube.	Number Colonies per c.c. Unfrozen Water.		Number Colonies per c.c. Thawed Ice.			Number of Tube.	Number Colonies per c.c. Unfrozen Water.		Number Colonies per c.c. Thawed Ice.		
I	4690	5390	0	0		**XVI**	0	9	0	0	
II	6440	5390	0	1		**XVII**	21840	17640	0	0	
III	7140	5320	0	1		**XVIII**	9520	14070	0	0	
IV	9870	12880	18	12	*	**XIX**	15960	8680	0	0	
V	5560	7210	3	4	*	**XX**	7910	16170	0	0	
VI	10080	11060	0	1		**XXI**	25410	30450	3	1	
VII	4060	3710	0	1		**XXII**	34020	31920	0	–	
VIII	4480	3990	0	2		**XXIII**	3	0	0	0	
IX	1	1	0	0		**XXIV**	20790	17640	0	–	
X	1	2	1	–		**XXV**	107730	103950	272	262	*
XI	147420	148050	0	–		**XXVI**	380	560	0	1	
XII	2	0	0	0		**XXVII**	0	0	0	0	
XIII	63630	71190	0	0		**XXVIII**	330	210	0	1	*
XIV	57960	48510	0	0		**XXIX**	150	280	0	0	
XV	87570	86940	1	0		**XXX**	1330	1440	0	0	

Tubes **I–X**, frozen February 17, 1899, in 3 hours; **XI–XX**, February 23, in 2 hours; **XXI–XXX**, March 3, in $1\frac{3}{4}$ hours; thawed after *1 week* in each case. Minimal temperature, –10° C.

* Colonies in ice proved to be typhoid. Colonies in ice in tubes not starred proved to be contaminations.

B. EXPERIMENTS ON THE EFFECT OF ALTERNATE FREEZING AND THAWING UPON THE BACILLI OF TYPHOID FEVER.

Dr. Prudden, as we have seen, considered intermittent more fatal than uninterrupted freezing, and, indeed, succeeded in one case in entirely sterilizing a tube inoculated with B. typhi by this method. Our four series of experiments on this subject were conducted by freezing tubes in the freezer as described in the previous section. The tubes of Series I, Race A, were frozen daily for five days and allowed to thaw each time after about eighteen hours, samples being planted after each thawing. Those of Series I, Race B, were frozen three times, on alternate days, remaining frozen for twenty-four hours each time and kept below 2° for the rest of the time. The two series in Race D were treated like the tubes frozen for three hours and six hours in the last section, except that instead of remaining frozen they were thawed and refrozen once and twice respectively during that time.

The results of these experiments with the results of simple freezing directly comparable are as follows: —

RACE A.

	Reduction
Frozen once in one day	96.1
Frozen twice in two days	98.9
Frozen three times in three days	99.5
Frozen four times in four days	99.8

RACE B.

Kept frozen for three days (see previous section, Race B, Series III)	98.4
Frozen twice in four days	99.6
Kept frozen for seven days (see previous section, Race B, Series II)	93.3
Frozen three times in six days	99.8

RACE D.

Kept frozen for three hours (see previous section, Race D, Series I)	74.8
Refrozen once in three hours	97.4
Kept frozen for six hours (see previous section, Race D, Series II)	97.0
Refrozen twice in six hours	99.5

CONCLUSION. Thawing and refreezing are somewhat more fatal than simple freezing in its effect on the typhoid bacillus. Four successive freezings and thawings do not, however, suffice to kill off the most resistant bacilli.

RACE A. SERIES I.

Number of Tube.	Average before Freezing.	After One Freezing.		After Two Freezings.		After Three Freezings.		After Four Freezings.	
		Average.	Reduction per cent.	Average.	Reduction per cent.	Average.	Reduction per cent.	Average.	Reduction per cent.
91	49910	—	—	—	—	—	—	—	—
92	22785	175	99.3	6	99.9	1	99.9	3	99.9
94	348390	26320	92.5	2495	99.3	644	99.9	147	99.9
95	308385	1735	99.5	171	99.9	59	99.9	2	99.9
96	167580	535	99.7	6	99.9	2	99.9	2	99.9
97	277515	40	99.9	1	99.9	3	99.9	2	99.9
98	50820	745	98.5	290	99.4	200	99.6	120	99.8
99	600	180	70.0	4	99.3	1	99.8	—	—
100	34090	190	99.4	55	99.9	16	99.9	8	99.9
111	76895	380	99.5	80	99.9	22	99.9	20	99.9
112	23875	685	97.1	355	98.5	33	99.9	13	99.9
113	29750	—	—	—	—	—	—	—	—
114	38290	265	99.3	40	99.9	3	99.9	0	100.0
115	31500	1785	94.3	1232	96.1	416	98.7	427	98.6
116	46585	75	99.8	3	99.9	23	99.9	3	99.9
117	21	17	—	15	—	2	—	2	—
118	48335	4450	90.8	3895	91.9	2440	95.0	—	—
119	38430	155	99.6	11	99.9	2	99.9	2	99.9
120	25200	215	99.1	14	99.9	2	99.9	3	99.9
	Averages		96.1		98.9		99.5		99.8

Tubes **91–100**, frozen March 28, 1898; thawed and sampled and refrozen, on each of the four days succeeding. Tubes remained frozen 18 hours each time.

Tubes **111–120**, treated in same manner week of April 11, 1898.

RACE B. SERIES I.

Number of Tube.	Average before Freezing.	After One Freezing.		After Two Freezings.		After Three Freezings.	
		Average.	Reduction per cent.	Average.	Reduction per cent.	Average.	Reduction per cent.
1	46950	420	99.1	67	99.9	38	99.9
2	22260	155	99.3	24	99.9	23	99.9
3	12810	315	97.5	21	99.8	19	99.9
4	12145	215	98.2	52	99.6	29	99.8
5	10640	20	99.8	10	99.9	7	99.9
6	8715	120	98.6	10	99.9	5	99.9
7	7945	80	99.0	13	99.8	9	99.9
8	4190	65	98.4	13	99.7	7	99.8
9	2520	85	96.6	9	99.6	4	99.8
10	2450	95	96.1	7	99.7	1	99.9+
11	115290	775	99.3	280	99.8	161	99.9
12	142695	1980	98.6	1008	99.3	356	99.8
13	183385	315	99.8	96	99.9	85	99.9+
14	74970	1140	98.5	595	99.2	354	99.5
15	138915	480	99.7	276	99.8	116	99.9
16	227745	11865	94.8	5733	97.5	458	99.8
17	104265	670	99.4	198	99.8	129	99.9
18	107730	1250	98.8	403	99.6	269	99.8
19	163485	650	99.6	139	99.9	65	99.9+
20	120015	390	99.7	171	99.9	75	99.9
	Averages		98.5		99.6		99.8

Tubes **1–10**, frozen April 10, 1899; kept frozen for 24 hours, and below 2° for 24 hours more; refrozen April 12 and April 14. Samples planted before each freezing and April 15.

Tubes **11–20**, treated in same way, April 17, and following days.

RACE D. SERIES I.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
101	78435	147	99.8
102	76230	451	99.4
103	1765	23	98.7
104	2730	47	98.3
105	275	15	94.5
106	7735	26	99.7
107	1120	49	95.6
108	11690	134	98.9
109	6895	235	96.6
110	—	—	—
131	—	—	—
132	—	—	—
133	3500	175	95.0
134	—	—	—
135	29190	77	99.7
136	20160	371	98.2
137	6055	192	96.8
138	5710	388	93.2
139	—	—	—
140	3885	144	96.3
Average			97.4

Tubes **101–110**, frozen May 5, 1899; thawed and refrozen in *3 hours*. Minimal temperature, (−13° C.).
Tubes **131–140**, frozen May 13, 1899; thawed and refrozen in *3 hours*. Minimal temperature, (−19° C.).

RACE D. SERIES II.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
111	34020	71	99.8
112	59090	152	99.7
113	13230	7	99.9
114	32525	274	99.2
115	1545	9	99.4
116	4270	29	99.3
117	2095	1	99.9+
118	6685	5	99.9
119	5250	68	98.7
120	13685	210	98.5
121	—	—	—
122	—	—	—
123	203175	3	99.9+
124	40005	1	99.9+
125	56070	2	99.9+
126	170100	297	99.8
127	—	—	—
128	—	—	—
129	—	—	—
130	925	1	99.9
Average			99.5

Tubes **111–120**, frozen May 9, 1899; thawed and refrozen twice in next *6 hours*. Minimal temperature, (−14° C.).
Tubes **121–130**, frozen May 10, 1899; thawed and refrozen twice in next *6 hours*. Minimal temperature, (−10° C.).

C. EXPERIMENTS ON THE EFFECT OF TEMPERATURES SLIGHTLY ABOVE THE FREEZING-POINT UPON TYPHOID BACILLI IN WATER.

In these experiments sterilized test tubes were inoculated with pure cultures as in all the preceding work. Afterward they were treated in one of three ways, — either placed in an incubator at the room temperature, 20° C., or in an ice-chest ranging from 8°–12°, or cooled in the freezer to a point just above freezing. This last was effected by filling the outer chamber with ice without salt.

In the three sets of tubes treated by the last method at 1°, the duration of exposure and the reduction were as follows: Race A in two hours was reduced 47.8 per cent; Race B in one and one-half hours was reduced 32.9 per cent; Race C in three hours was reduced 80.1 per cent. The reductions for the same races actually frozen for the nearest corresponding periods, were 73.6 per cent, 41.4 per cent, and 99.5 per cent, respectively. Each race maintains its relative position of resistance. The reduction in the chilled water is very nearly as great as in the ice; and the difference is only what the temperature difference might be expected to produce. Evidently there

is nothing mysterious about the act of freezing, no mechanical crushing of bacteria; the process of destruction is continuous above and below the freezing-point, depending upon the two main factors of time and temperature.

Series II and III of Races B and C cover longer periods of time and higher temperatures. Half of the tubes in each series were kept at 10° and half at 20°, but no marked differences appeared as the result of these two modes of treatment, and the two sets are averaged together in each series. The tubes were kept in these experiments for two weeks, one-half of them being sampled on the second and the seventh day, the others on the third day and the fourteenth. The tubes were, of course, protected from the action of light.

	Race B.		Race C.	
	Reduction per cent.		Reduction per cent.	
Time.	Series II.	Series III.	Series II.	Series III.
1 day	92.2	78.7	88.4	71.0
3 days	99.3	86.7	90.4	83.3
7 days	99.9	99.3	94.1	89.6
14 days	99.9	98.8	99.9	99.9

It will be noted that with each race the second series shows a greater reduction than the third. The explanation for this lies in the fact that these experiments were carried on some time after the regular experiments on freezing their respective races. During the intervening period the germs had been grown on agar, and the first new series of experiments with each race showed an extraordinary reduction, over 99 per cent in a day, etc. The results of this series have not been tabulated. The second series of each race, Series II above, showed more moderate, but still high reductions; while by the time the third series was inoculated, a week later, the cultures, by cultivation in bouillon, had regained their normal condition.

The tubes inoculated with Race D were kept for twenty-four hours only, samples being planted after 3, 6, 12, and 24 hours. Series I was kept at 20° and Series II at 10°.

	After 3 hours.	6 hours.	12 hours.	24 hours.
Series I (20°)	70.8	72.6	85.7	88.4
Series II (10°)	63.1	74.0	87.4	95.5

Conclusions. From these experiments it appears that typhoid fever bacilli behave in water much as they do in ice. A large proportion of them are killed by a few minutes' exposure to the unfavorable conditions; during the next few hours the reduction proceeds *pari passu* with the duration of the experiment; while a few germs persist for some time.

The results differ from those obtained by actual freezing in two respects. We have seen that freezing for short periods produced varying and uncertain results, while ice over twenty-four hours old showed a constant reduction of over 90 per cent. The tubes of water which were not frozen remained subject to this uncertainty for a much longer period. Inspection of the tables will show that individual tubes contained sometimes half of their original germ content after a week, or four-fifths of it after three days. On the other hand, complete sterilization ensued more often than in the frozen tubes.

A second characteristic of the viability of the germs in water is the fact, closely allied to the first, that an increase seems sometimes to occur. The successive samplings of the same tube show in certain instances a slight multiplication.

The reduction in water at 10° does not seem to be any greater than at 20°.

RACE A. SERIES I.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
131	140490	51450	63.4
132	505	10	98.0
133	10640	11410	0.0
134	12390	6965	43.8
135	31465	165	99.5
136	273105	87885	67.8
137	17745	9870	44.4
138	112770	63000	44.1
141	254205	105840	58.4
142	157815	92610	41.3
143	72135	42490	41.1
145	302715	302715	0.0
146	141750	45990	67.6
147	17360	21735	0.0
Average			47.8

Tubes **131-138**, cooled down to 1° C. in $1\frac{1}{4}$ hours, April 25, 1898. Kept at that temperature for $\frac{1}{2}$ hour more.
Tubes **141-147**, cooled down to 1° C. in $1\frac{1}{2}$ hours, April 29, 1898. Kept at that temperature for $\frac{1}{2}$ hour more.

RACE B. SERIES I.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
131	1946	1690	13.2
132	1610	1001	37.8
133	1848	1165	37.0
134	1571	1183	24.7
135	1379	1155	16.1
136	1291	1505	0.0
137	1232	1438	0.0
138	874	962	0.0
139	892	1473	0.0
140	1022	1051	0.0
141	4095	5	99.9
142	260	50	80.8
143	205	90	56.1
144	270	55	79.6
145	40	5	87.5
146	215	145	32.6
147	290	275	5.2
148	225	140	37.8
149	215	120	44.2
150	80	75	6.3
Average			32.9

Tubes **131-140**, cooled down to 0°, without freezing, and kept at that temperature for $1\frac{1}{2}$ hours. Date, December 29, 1898.
Tubes **141-150**, cooled down to 0°, without freezing, and kept at that temperature for $1\frac{1}{2}$ hours. Date, January 2, 1899.

RACE C. SERIES I.

Number of Tube.	Average Number Bacteria per c.c.		Reduction per cent.
	Unfrozen Water.	Thawed Ice.	
121	55125	14910	73.0
122	244755	217350	11.2
123	66465	11045	83.4
124	62685	59010	5.9
125	211050	32760	84.5
126	269955	75915	71.9
127	103005	7385	92.8
128	105840	8085	92.4
129	67725	20685	69.5
130	23100	4725	79.5
131	139860	9660	93.1
132	76545	3675	95.2
133	58275	6580	88.7
134	219135	23205	89.4
135	82530	3675	95.6
136	84105	3150	96.3
137	1290	0	100.0
138	38850	2105	94.6
139	30030	860	97.1
140	5530	640	88.4
Average			80.1

Tubes **121-130**, cooled down to 0° in $\frac{1}{2}$ hour, February 6, 1899; kept at that temperature (not frozen) for three hours.
Tubes **131-140**, cooled down to 0° in $\frac{1}{2}$ hour, February 7, 1899; kept at that temperature (not frozen) for 3 hours.

RACE B. SERIES II.

Number of Tube.	Average after Inoculation.	After One Day.		After Three Days.		After Seven Days.		After Fourteen Days.	
		Average.	Reduction per cent.	Average.	Reduction per cent.	Average.	Reduction per cent.	Average.	Reduction per cent.
201	232155	20	99.9+			2	99.9+		
202	93870	6755	92.8			0	100.0		
203	104895	4515	95.7			0	100.0		
204	9345	1180	87.4			0	100.0		
205	72135	60	99.9			1	99.9+		
206	51660			0	100.0			0	100.0
207	56070			1837	96.3			3	99.9+
208	1515			0	100.0			0	100.0
209	216405			2972	98.8			21	99.9+
210	Control			Con	trol			Con	trol
211	11025	0	100.0			1	99.9+		
212	17885	5075	71.6			51	99.7		
213	20790	90	99.6			0	100.0		
214	10420	30	99.7			0	100.0		
215	81270	2020	75.2			73	99.9		
216	10640			1	99.9+			1	99.9+
217	825			0	100.0			8	99.0
218	170			1	99.4			0	100.0
219	22330			5	99.9+			0	100.0
220	74340			623	99.2			3	99.9+
	Averages		92.2		99.3		99.9		99.9

Tubes **201–210**, inoculated March 17, 1899; kept in ice-chest at about 10° C.
Tubes **210–220**, inoculated March 17, 1899; kept in room at about 20° C.

RACE B. SERIES III.

Number of Tube.	Average after Inoculation.	After One Day.		After Three Days.		After Seven Days.		After Fourteen Days.	
		Average.	Reduction per cent.	Average.	Reduction per cent.	Average.	Reduction per cent.	Average.	Reduction per cent.
221	113400	21630	80.8			2467	97.8		
222	74340	385	99.5			3	99.9+		
223	74340	13405	82.0			1043	98.6		
224	48510	7840	83.8			1043	97.8		
225	137025	2425	98.2			0	100.0		
226	17535			1389	92.1			0	100.0
227	103635			40446	61.0			6835	93.4
228	74655			27405	63.3			1603	97.9
229	25200			2520	90.0			28	99.9
230	85050			7465	91.2			112	99.9
231	34650	5355				30	99.9		
232	18795	6930				5	99.9+		
233	7320	1205				39	99.5		
234	5145	3420				9	99.8		
235	5565	1195				16	99.7		
236	5075		84.5	22	99.6			1	99.9+
237	10535		63.1	312	97.0			2	99.9+
238	4340		83.5	28	99.3			3	99.9
239	17955		33.5	4284	76.1			486	97.3
240	6090		78.5	173	97.2			3	99.9+
	Averages		78.7		86.7		99.3		98.8

Tubes **221–230**, inoculated March 24, 1899; kept in ice-chest at about 10° C.
Tubes **231–240**, inoculated March 24, 1899; kept in room at about 20° C.

RACE C. SERIES II.

Number of Tube.	Average after Inoculation.	After One Day.		After Three Days.		After Seven Days.		After Fourteen Days.	
		Average.	Reduction per cent.	Average.	Reduction per cent.	Average.	Reduction. per cent.	Average.	Reduction per cent.
141	68985	1596	97.7			30	99.9+		
142	81270	10206	87.4			1043	98.7		
143	143640	1141	99.2			56	99.9+		
144	198450	107730	45.7			125956	36.5		
145	132300	1883	98.6			38	99.9+		
146	198450			13041	93.4			196	99.9
147	210735			2142	99.0			30	99.9+
148	80325			238	99.9+			2	99.9+
149	82215			479	99.9			2	99.9+
150	79065			228	99.9+			0	100.0
151	51345	1176	97.7			2	99.9+		
152	66780	14238	78.7			501	99.2		
153	349650	11970	96.9			128	99.9+		
154	73395	7	99.9+			0	100.0		
155	230580	40761	82.3			8347	96.4		
156	168210			135229	19.6			54	99.9+
157	41265			1400	96.6			22	99.9
158	17395			16	99.9			1	99.9+
159	83790			3402	95.9			5	99.9+
160	120015			42	99.9+			3	99.9+
	Averages		88.4		90.4		94.1		99.9

Tubes **141–150**, inoculated March 20, 1899; kept in ice-chest at 10°.
Tubes **151–160**, inoculated March 20, 1899; kept in room at about 20° C.

RACE C. SERIES III.

Number of Tube.	Average after Inoculation.	After One Day.		After Three Days.		After Seven Days.		After Fourteen Days.	
		Average.	Reduction per cent.	Average.	Reduction per cent.	Average.	Reduction per cent.	Average.	Reduction per cent.
161	10535	15	99.9			1	99.9+		
162	26985	5	99.9+			1	99.9+		
163	44205	30660	30.6			242	99.5		
164	5705	30	99.4			0	100.0		
165	340	230	32.4						
166	41685			7497	82.0			119	99.7
167	1080			45	95.8			1	99.9
168	24465			2709	88.9.			14	99.9
169	15330			15876	0.0				
170	Control			Control				Con	trol
171	420	40	90.5			0	100.0		
172	1205	805	33.2			1	99.9		
173	305	0	100.0			1	99.7		
174	19740	9275	53.0			609	96.9		
175	1065	310	70.9			2	99.8		
176	3255			46	98.6			1	99.9+
177	4105			271	93.4			2	99.9+
178	1725			1	99.9			0	100.0
179	620			0	100.0			2	99.7
180	17850			1596	91.1			48	99.7
	Averages		71.0		83.3		89.6		99.9

Tubes **161–170**, inoculated March 27, 1899; kept in ice-chest at 10°.
Tubes **171–180**, inoculated March 27, 1899; kept in room at about 20° C.

RACE D. SERIES I.

Number of Tube.	Average after Inoculation.	After Three Hours.		After Six Hours.		After Twelve Hours.		After Twenty-four Hours.	
		Average.	Reduction per cent.	Average.	Reduction per cent.	Average.	Reduction per cent.	Average.	Reduction per cent.
141	2590	30	98.8	0	100.0	5	99.8	5	99.8
142	5670	25	99.5	20	99.6	0	100.0	5	99.9
143	2315	5	99.8	225	90.3	0	100.0	10	99.6
144	3185	140	95.6	90	97.2	20	99.4	0	100.0
145	15	10	33.3	15	0.0	10	33.3	—	—
146	340	70	79.4	60	82.4	10	97.1	25	92.6
147	745	30	96.0	210	71.8	5	99.3	10	98.7
148	50	35	30.0	0	100.0	0	100.0	20	60.0
149	45	30	33.3	50	0.0	0	100.0	5	88.9
150	230	40	82.6	5	97.8	5	97.8	5	97.8
151	52920	22890	56.7	18690	64.7	7969	84.9	770	98.5
152	8680	6300	27.4	3780	56.5	1704	80.1	483	94.4
153	68670	28350	58.7	26885	60.8	21168	69.2	20097	70.7
154	43155	715	98.3	385	99.1	252	99.4	119	99.7
155	6650	1025	84.6	380	94.3	273	95.9	158	97.6
156	41895	7000	83.3	7105	83.0	5323	87.3	4410	89.5
157	74025	12355	83.3	14700	80.1	11056	85.1	6647	91.0
158	53235	7980	85.0	13125	75.3	14647	72.5	5386	89.9
159	23205	6090	73.8	9695	58.2	8064	65.2	10206	56.0
160	3255	2745	16.0	1925	40.9	1669	48.7	1480	54.5
	Averages		70.8		72.6		85.7		88.4

Tubes **141–150**, inoculated May 11, 1899. Kept at room temperature.
Tubes **151–160**, inoculated May 15, 1899. Kept at room temperature.

RACE D. SERIES II.

Number of Tube.	Average after Inoculation.	After Three Hours.		After Six Hours.		After Twelve Hours.		After Twenty-four Hours.	
		Average.	Reduction per cent.	Average.	Reduction per cent.	Average.	Reduction per cent.	Average.	Reduction per cent.
161	27615	7455	73.9	5810	79.0	—	—	6268	77.3
162	291060	47145	83.8	21000	92.8	—	—	3895	98.7
163	200340	11235	43.9	205	99.9	—	—	1	99.9+
164	208530	24045	88.5	10500	95.0	—	—	5261	97.5
165	178605	1860	99.0	355	99.8	—	—	21	99.9+
166	54810	7000	87.2	—	—	—	—	—	—
167	106785	11655	89.1	2275	97.9	—	—	1543	86.4
168	212625	4130	98.1	1385	99.4	—	—	2001	99.1
169	25095	1960	92.2	745	97.1	—	—	529	97.9
170	2660	145	94.5	35	98.7	—	—	129	95.2
171	236250	95445	59.6	78435	66.8	25578	89.2	3643	98.5
172	240975	120330	50.1	144585	40.0	45360	81.3	20128	91.8
173	199395	98595	50.6	41840	79.0	16065	91.9	196	99.9
174	299565	150255	49.8	156200	47.8	29578	90.1	5691	98.1
175	179550	104895	41.6	54180	69.8	9670	94.4	2992	98.3
176	107730	64260	40.4	72265	32.9	17010	84.2	2396	97.8
177	133235	69930	47.5	81900	38.5	17671	86.7	7140	94.6
178	141750	89515	36.8	35700	74.8	20790	85.3	1101	99.2
179	211680	226800	0.0	158760	25.0	56891	73.1	31468	85.1
180	47565	30765	35.3	8610	71.9	1141	97.6	288	99.4
	Averages		63.1		74.0		87.4		95.5

Tubes **161–170**, inoculated May 17, 1899. Kept in ice-chest at 10°.
Tubes **171–180**, inoculated May 19, 1899. Kept in ice-chest at 10°.

D. EXPERIMENTS ON THE VIABILITY OF TYPHOID FEVER BACILLI IN EARTH AT VARIOUS TEMPERATURES.

These experiments were carried on in order to compare the conditions affecting a reduction of the number of typhoid bacilli in soil, with those operating on them in water and ice. The general method pursued was the same, the inoculation of numerous small portions of a sterile medium with a pure culture of the micro-organism. In each series of experiments about one hundred grains of sifted clayey soil were sterilized by baking for sixteen hours, on two successive days. The whole of the earth was then inoculated by mixing with it a bouillon culture two or three days old, of B. typhi, Race B; and an even distribution was accomplished by stirring and kneading with a spatula. The earth, having been dried by the previous baking, absorbed the bouillon culture without becoming visibly damp. Fifty portions of the inoculated earth of one gram each were then weighed out and placed in fifty sterile empty test-tubes. Of these fifty portions, ten were at once mixed with sterile water and two check plates made from each flask. The remaining forty tubes were carried to the cold storage warehouse or kept at the room temperature, as the case might be, in either condition being protected from the action of light. After one day, three days, one week, and two weeks, ten tubes were removed and planted. In every case the entire gram of earth was mixed with ten, one hundred or nine hundred cubic centimeters of sterile water; and two check plates were made from the dilution.

The inoculation, weighing and tubing of the earth, were conducted in a glass chamber some three feet square, with a sliding door raised only sufficiently to admit the arms of the operator. Control plates were made from four portions of the earth before inoculation, the portions of a gram apiece being tubed and planted exactly like the regular tubes. The following were the results per gram: —

COLONIES PER GRAM.

1		2		3		4	
14	1	0	3	0	0	360	0

The tubes of the first three series were kept at the cold storage warehouse during the period of the experiment, at 0° C. Those of the fourth series were kept at the room temperature. The summarized average results of these four series are as follows: —

Typhoid Bacilli in Earth. Average Number per Gram.

	After Inoculation.	After 1 day.	3 days.	7 days.	14 days.
Series I 0°	180776	4635	705	25	9
II 0°	4846855	95017	1395	525	588
III 0°	7778595	324588	4656	1304	1160
IV 20°	4673683	2565	450	95	92

Two more series of experiments with earth were carried out to throw light on the part played by dryness in the reduction manifest in the first experiments. In these latter researches the sets of fifty tubes were inoculated just as before, and ten of them were planted at once. The remaining forty were divided into two portions. The gram of earth in each of twenty of the tubes was moistened by the addition of about one-third cubic centimeter of sterilized tap water; while the earth in the other twenty tubes was left in its comparatively dry condition. The tubes were all kept at the room temperature. Thus a comparison may be drawn as to the viability of the germ in damp and in dry earth. The results were as follows:—

Typhoid Bacilli in Dry and Damp Earth. Average Number per Gram.

	After Inoculation.		After 1 day.	3 days.	7 days.	14 days.
Series V	939115	Dry	2070	50	2	47
		Damp	225	7010	1295	8
VI	1198260	Dry	566	71	12	4
		Damp	1699110	—	—	29587

Conclusions. 1. The typhoid bacilli in dry earth behave just as in water and in ice. They die out, rapidly at first, and their numbers are progressively reduced as the treatment is prolonged. A fraction of one per cent persists for some time.

2. Cold alone does not materially affect the reduction of typhoid germs in dry earth.

3. In moist earth, although the main phenomena are the same, the destruction of the bacteria is much less rapid. With the liberal food supply introduced with the bouillon in these experiments, they appear sometimes to hold their own entirely.

TYPHOID BACILLI IN EARTH.

Series I.

Number of Tube.	February 13, 1899. Bacteria per gram.		Number of Tube.	February 14, 1899. Bacteria per gram.	
1	233000	243000	**11**	5400	1800
2	217000	—	**12**	4500	4500
3	114000	112000	**13**	7200	1800
4	123000	120000	**14**	6300	4500
5	504000	207000	**15**	2700	3600
6	107000	126000	**16**	900	5400
7	178000	141000	**17**	1800	13500
8	157000	153000	**18**	8100	9900
			19	3600	1800
			20	2700	2700
	Average	180776		*Average*	4635

Number of Tube.	February 16, 1899. Bacteria per gram.		Number of Tube.	February 20, 1899. Bacteria per gram.		Number of Tube.	February 27, 1899. Bacteria per gram.	
21	900	600	**31**	30	10	**41**	20	0
22	1000	900	**32**	10	0	**42**	30	40
23	900	200	**33**	90	50	**43**	10	0
24	600	400	**34**	0	10	**44**	0	0
25	900	1600	**35**	0	0	**45**	20	0
26	900	400	**36**	30	0	**46**	20	0
27	400	700	**37**	0	80	**47**	0	0
28	300	400	**38**	30	70	**48**	0	30
29	900	800	**39**	10	40	**49**	0	0
30	400	700				**50**	0	0
	Average	705		*Average*	25		*Average*	9

Tubes kept at 0° C.

SERIES II.

Number of Tube.	February 20, 1899. Bacteria per gram.		Number of Tube.	February 21, 1899. Bacteria per gram.	
1	4932900	5896800	11	130500	175500
2	5046300	4649400	12	103500	—
3	5216400	4876200	13	119700	81900
4	2286900	4706100	14	55800	70200
5	5953500	7030800	15	54000	51300
6	2570400	3628800	16	102600	—
7	5159700	4309200	17	41400	37800
8	6860700	5443200	18	117900	140400
9	3686500	4989600	19	114300	115200
			20	126900	74700
	Average	4846855		*Average*	95017

Number of Tube.	February 23, 1899. Bacteria per gram.		Number of Tube.	February 27, 1899. Bacteria per gram.		Number of Tube.	March 6, 1899. Bacteria per gram.	
21	1200	1300	31	30	110	41	340	400
22	1400	1900	32	210	310	42	160	110
23	700	1700	33	60	240	43	1770	750
24	500	1200	34	660	470	44	1070	1690
25	1100	800	35	110	90	45	160	200
26	300	700	36	240	290	46	160	900
27	2200	4000	37	310	500	47	120	800
28	2600	3100	38	820	210	48	360	430
29	1100	700	39	190	240			
30	400	1000	40	2890	2620			
	Average	1395		*Average*	525		*Average*	588

Kept at 0° C.

Series III.

Number of Tube.	February 24, 1899. Bacteria per gram.		Number of Tube.	February 25, 1899. Bacteria per gram.	
1	8541900	7144200	**11**	466200	522900
2	6747300	7200900	**12**	529200	229500
3	7314300	6066900	**13**	409500	621100
4	10432800	10092600	**14**	415800	371700
5	7711200	6917400	**15**	270900	258300
6	6860700	7597800	**16**	289800	216900
7	7881300	8278200	**17**	573300	346500
8	8731800	6577200	**18**	144900	171100
9	6463800	7711200	**19**	5400	3600
10	9695700	7994700			
	Average	7778595		*Average*	324588

Number of Tube.	February 27, 1899. Bacteria per gram.		Number of Tube.	March 3, 1899. Bacteria per gram.		Number of Tube.	March 10, 1899. Bacteria per gram.	
21	1600	1400	**31**	220	370	**41**	1710	420
22	2400	1500	**32**	380	250	**42**	1390	350
23	6900	7300	**33**	3710	370	**43**	1770	—
24	1500	900	**34**	310	—	**44**	—	—
25	1600	2600	**35**	3290	240	**45**	2870	2150
26	4000	3600	**36**	5530	2310	**46**	660	420
27	1900	1600	**37**	930	270	**47**	160	210
28	10500	25200	**38**	690	480	**48**	1510	40
			39	1020	4410	**49**	1360	1450
			40	190	140	**50**	2420	1220
	Average	4656		*Average*	1304		*Average*	1160

Kept at 0° C.

SERIES IV.

Number of Tube.	February 28, 1899. Bacteria per gram.		Number of Tube.	March 1, 1899. Bacteria per gram.	
1	4139100	6010200	**11**	10800	4500
2	3742200	4876200	**12**	2700	900
3	3798900	2721600	**13**	2700	1800
4	3685500	—	**14**	900	900
5	5896800	7144200	**15**	1800	2700
6	5216400	5556600	**16**	900	900
7	4025700	3628800	**17**	1800	900
			18	900	0
			19	5400	7200
			20	1800	1800
	Average	4673683		*Average*	2565

Number of Tube.	March 3, 1899. Bacteria per gram.		Number of Tube.	March 7, 1899. Bacteria per gram.		Number of Tube.	March 14, 1899. Bacteria per gram.	
21	900	1800	**31**	20	10	**41**	10	0
22	900	0	**32**	20	30	**42**	140	380
23	0	900	**33**	60	20	**43**	20	170
24	1800	0	**34**	30	10	**44**	130	110
25	900	0	**35**	90	10	**45**	350	30
26	0	0	**36**	690	60	**46**	160	60
27	0	0	**37**	340	100	**47**	40	0
28	0	900	**38**	120	20	**48**	40	20
29	0	0	**39**	250	0	**49**	190	0
30	900	0	**40**	10	10			
	Average	450		*Average*	95		*Average*	92

* Kept at 20° C.

Series V.

AFTER INOCULATION.

Number of Tube.	March 15, 1899. Bacteria per gram.	
1	1045800	863100
2	1140300	989100
3	1663200	1499400
4	573300	938700
5	592200	686700
6	1297800	863100
7	1348200	—
8	1004400	919800
9	1026900	636300
10	888300	875700
	Average	939115

DAMP EARTH.

	Number of Tube.	Bacteria per gram.		Averages.
March 16	**11**	0	0	
	12	900	0	
	13	0	900	
	14	0	0	225
March 18	**21**	0	0	
	22	100	0	
	23	21100	25100	
	24	8400	15000	
	25	400	0	7010
March 22	**31**	220	180	
	32	10	0	
	33	3360	6580	
	34	0	10	
	35	—	—	1295
March 29	**41**	40	40	
	42	0	0	
	43	0	0	
	44	0	0	
	45	0	0	8

DRY EARTH.

	Number of Tube.	Bacteria per gram.		Averages.
March 16	**16**	900	900	
	17	9000	1800	
	18	0	2700	
	19	900	3600	
	20	0	900	2070
March 18	**26**	200	0	
	27	100	0	
	28	100	100	
	29	0	0	
	30	0	0	50
March 22	**36**	0	0	
	37	0	0	
	38	0	0	
	39	10	0	
	40	0	10	2
March 29	**46**	10	30	
	47	260	100	
	48	20	0	
	49	20	0	
	50	10	20	47

Series VI.

AFTER INOCULATION.

Number of Tube.	March 29, 1899. Bacteria per gram.	
1	1455300	1379700
2	1682100	1455300
3	1152900	1228500
4	1083600	825300
5	926100	1152900
6	1304100	1020600
7	1152900	1568700
8	1115100	1266300
9	926100	1096200
10	1398600	774900
	Average	1198260

DAMP EARTH. DRY EARTH.

	Number of Tube.	Bacteria per gram.		Averages.		Number of Tube.	Bacteria per gram.		Averages.
March 30	11	1341900	1266300		March 30	16	200	300	
	12	2060100	1719900			17	600	4200	
	13	1436400	1247400			18	50	130	
	14	2891700	3364200			19	60	40	
	15	963900	699300	1699110		20	60	20	566
April 1	21				April 1	26	30	40	
	22					27	320	20	
	23					28	70	40	
	24					29	—	—	
	25			—		30	0	50	71
April 5	31				April 5	36	0	0	
	32					37	10	10	
	33					38	10	30	
	34					39	10	10	
	35			—		40	0	40	12
April 12	41	33300	41400		April 12	46	10	12	
	42	900	0			47	6	5	
	43	1800	1800			48	—	—	
	44	88200	69300			49	1	2	
				29587		50	1	4	4

E. EXPERIMENTS ON THE EFFECTS OF SEDIMENTATION AND CRYSTALLIZATION DURING THE FREEZING OF TYPHOID FEVER BACILLI IN WATER.

In the experiments under Section I, the reduction effected represented simply the death-rate among the bacteria due to the adverse conditions. All the bacteria in the unfrozen water which did not perish must, from the nature of the case, be present in the thawed ice. In nature, however, the conditions are widely different. Ice is formed immediately over and in immediate contact with a large body of water. In the water, before and during the process of freezing, the bacteria, being particles somewhat heavier than water, continually tend to settle out from the region where ice is to form and fall gradually to the bottom. And when the ice formation actually takes place, a still more powerful force comes into play. In the process of crystallization there is a strong tendency to throw out all substances other than the pure compound chiefly concerned. If, then, soluble chemical compounds, other than hydrogen monoxide are excluded to a large extent when water freezes, this must be still more the case with suspended particles like the bacteria.

These *a priori* conclusions are strengthened by the work of Pengra and of the Massachusetts State Board of Health as well as by common scientific knowledge. To test them more carefully with respect to Bacillus typhi abdominalis and Bacillus coli the following experiments were made. A new wine-cask, of about ten gallons capacity, was allowed to stand full of water for a few days in order to remove any extractives present. Four pet-cocks were then screwed in, on opposite sides of the cask, two about four inches from the top and the others an inch or so from the bottom. The whole cask was jacketed with felt so that when placed at a low temperature it would freeze from above down and not from the sides inward. It was then filled with water, at about the boiling-point, drawn from an ordinary water-heater. This water was then allowed to stand for twenty-four hours, when it was found cool and still very nearly sterile, containing three or four germs per cubic centimeter. The barrel of water was then inoculated by pouring into it a bouillon culture of the germ used, the common colon bacillus in the first four experiments, the typhoid bacillus, Race B, in the last two. During the course of the experiments no sterilization was attempted beyond that partially effected by the boiling water. After adding the culture and stirring with a sterile rod, samples were taken from the four pet-cocks and planted. The covered cask was then set aside in the room or placed on a broad sill just outside the window of the laboratory, where it was exposed

to the winter's cold. After twenty-four hours of this treatment a thin sheet of ice a quarter to half an inch thick was found covering the surface. Samples were again taken from the upper cocks just under the ice, and from the lower cocks at the bottom of the barrel, and portions of the ice were also planted, being melted in sterile bottles, after washing with the water produced by their own melting, according to the usual technique.

CONCLUSIONS. 1. These experiments indicate that sedimentation does not produce marked or constant effects on colon and typhoid bacilli in water during as short a period as twenty-four hours.

2. On the other hand, the experiments show that ice formed on the surface of a quiet body of water contains only about ten per cent of the bacteria present in the water just below. This difference is probably due to the physical exclusion by the process of crystallization and not to any germicidal action, as the temperature of the ice can only differ from that of the adjacent water by a very slight amount. There are two distinct forces at work, — the low temperature, killing out germs in the ice and water nearly equally, and the crystallizing process extruding germs from the ice into the water below.

REDUCTION OF BACTERIA BY SEDIMENTATION.

B. COLI. SERIES I.

Bacteria per c.c. in samples taken from top and bottom of cask.

					Averages.
	December 29, 1898.				
Top	60270	51870	19320	18900	42590
Bottom	3570	3680	4550	4310	4028
	December 30, 1898.				
Top	11200	15610	12390	10095	12324
Bottom	51030	44730	13020	13580	30590
	December 31, 1898.				
Top	7070	6860	5110	5495	6132
Bottom	51870	8120	5845	40740	26640

Kept in room.

SERIES II.

					Averages.
	January 3, 1899.				
Top	120960	110880	114660	101430	114480
Bottom	114030	97650	103320	85050	100012
	January 4, 1899.				
Top	54180	42840	60910	56070	53500
Bottom	52920	47880	60270	62160	56050

Put outdoors. Temperature −5° to −10° C. Surface did not freeze.

REDUCTION OF BACTERIA BY SEDIMENTATION AND BY FORMATION OF ICE ON FREE SURFACE.

B. Coli. Series III.

					Averages.
	January 9, 1899.				
Top	28560	21630	23100	20370	23415
Bottom	25620	10010	32760	12180	20142
	January 10, 1899.				
Ice	370	250	550	670	460
Water { Top	4620	4900	—	—	4380
Water { Bottom	4410	10360	7490	7700	7490

Put outside. Temperature −1° C. ¼ inch ice formed.

Series IV.

					Averages.
	January 11, 1899.				
Top	69930	62370	45990	76860	63787
Bottom	57330	61110	68670	77490	66150
	January 12, 1899.				
Ice	1240	950	1890	780	1215
Water { Top	15720	11760	9870	8410	11440
Water { Bottom	8820	10920	13090	13020	11462

Put outside. Temperature, −15° C. ¼ inch ice formed.

B. Typhi. Series I.

					Averages.
	January 18, 1899.				
Top	147420	226800	198450	204120	194197
Bottom	247590	211680	245700	153090	214515
	January 19, 1899.				
Ice	21840	28350	27090	23940	25305
Water { Top	234360	194670	147420	145530	180495
Water { Bottom	209790	176660	232470	181440	200090

Put outside. ⅛ inch ice formed.

Series II.

					Averages.
	January 19, 1899.				
Top	202230	198450	156870	171990	182385
Bottom	154980	218610	302400	254520	232627
	January 20, 1899.				
Ice	68040	75600	18480	17430	44887
Water { Top	270270	404460	578340	319960	393257
Water { Bottom	307180	257040	386820	238140	297295

Put outside. ¼ inch ice formed.

IV. DEDUCTIONS FROM THE EXPERIMENTS CONCERNING ICE AS A VEHICLE OF INFECTIOUS DISEASE, WITH SPECIAL REFERENCE TO THE PROBLEMS OF ICE-SUPPLY AND THE PUBLIC HEALTH.

Reviewing the several series of experiments described in detail above, and keeping carefully in mind the conditions under which natural ice is formed, cut, harvested, stored, delivered, and finally consumed, as well as those pertaining to the manufacture, distribution, and consumption of artificial ice, certain conclusions appear to be justified concerning ice as a vehicle of disease; and these conclusions are, on the whole, decidedly reassuring.

The conditions which tend naturally to purify polluted waters, are now well understood. Light, cold and poor food-supply are antiseptic or disinfectant agents of considerable power; hostile infusoria may devour the living germs of infectious disease; the chemical composition of the water may be unfavorable to their survival; and gravity may cause them to settle to the bottom, where they may soon perish for want of air. The main factor determining the reduction of germs in water is, however, the *time*, — the time during which these and other forces are left to act. Epidemiology shows clearly that disease follows best a direct, quick transfer of infectious material from patient to susceptible victim; and, if storage of water for some months could be insured, many sanitarians would consider such storage a sufficient purification.

In ice we have this condition realized, — a forced storage of at least weeks and at best of many months. At the same time the other effective conditions are also heightened. It is no wonder, then, that our experiments show a reduction of over 99 per cent in typhoid bacilli frozen; and we may be sure that in nature the destruction would exceed, rather than fall short of, such a limit.

This reduction obtains in tubes which are frozen solid, where there is no chance for mechanical exclusion. In natural ice there is another purifying influence. Of the germs remaining in the water at the time of freezing, 90 per cent are thrown out by the physical phenomena of that process. This reduction is separate from, and supplementary to, the disinfecting action of the cold. Accordingly, when both factors work together, it is obvious that only one out of a thousand typhoid germs present in a polluted stream has a chance of surviving in the ice.

Under natural conditions the pathogenic germs present in the most highly polluted stream are comparatively few. Of these few, one-tenth of one per cent may be present in ice derived therefrom. But even these scattered individuals are weakened by their sojourn under unfavorable conditions, so that, as we have seen,

they require nearly twice as long for their development as do the normal germs, and these few and weakened germs very likely could not produce many, if any, cases of typhoid fever, for vitality and virulence in disease germs are probably closely related.

With artificial ice the case is somewhat different, for such ice is made from water frozen solid, and is, as a rule, quickly consumed. Artificial ice, if made from pure water, should be above reproach; but if it be made from water that is impure it may contain the germs of infectious disease; and inasmuch as artificial ice is used quickly after its manufacture, the possibility of purification by time is excluded, and such ice might therefore conceivably be a menace to the public health.

With natural ice, as long as absolute sterilization is not effected, there must always remain a certain element of doubt, as in the use of sand filters, alluded to above, or in the practice of room-disinfection after contagious diseases. The thickness of a layer of ice is often artificially increased by cutting holes in it and flooding that already formed with the water of the pond. In such a case the effects of crystallization are excluded, as in the laboratory tubes. Ice thus formed might be cut at once, and served within a week or two; and in such an exceptional case we cannot say that sufficient of the virus might not persist to excite the malady. Yet such an instance must be very exceptional; and the general result of human experience, the absence of epidemics of typhoid fever traced conclusively to ice, the fact that cities like New York, and Lowell and Lawrence in Massachusetts, have used the ice of polluted streams, and have yet maintained low death-rates from typhoid fever, all tend to support the conclusion at which we have arrived, namely, that natural ice can very rarely be a vehicle of typhoid fever.

PART II.

STATISTICAL STUDIES ON THE SEASONAL PREVALENCE OF TYPHOID FEVER IN VARIOUS COUNTRIES AND ITS RELATION TO SEASONAL TEMPERATURE.

I. A REVIEW OF THE LITERATURE ON THE SEASONAL PREVALENCE OF TYPHOID FEVER.

THE variations in the prevalence of typhoid fever with the changing seasons was one of the characteristics of that remarkable disease which struck the very earliest observers. Elisha Bartlett, in 1842,[87] wrote of it as follows: "It is not settled whether typhoid fever occurs, with any degree of uniformity, more frequently in one season of the year than in another. . . . I am sure, however, that, as a general rule, its annual prevalence is greatest in the autumn. In New England it is not unfrequently called the autumnal or fall fever."

Dr. Flint, in 1855,[88] pointed out as one of the points of distinction between typhus and typhoid fever that while the former is unaffected by season, the latter "manifests a predilection for the autumnal months, although it is by no means restricted in its occurrence to the latter." Griesinger, a little later,[89] noted that in middle Europe and North America the majority of cases as well as the epidemic outbreaks occurred most abundantly in autumn, and that the winter typhoid stood next in relative intensity, followed by that of summer, while the fewest cases occurred in the spring. He quoted Lombard as authority for the fact that in Geneva the month of October shows seven times as many typhoid cases as the month of March. In 1860, Dr. Tweedie[90] published a table of the admissions of the different forms of continued fever into the London Fever Hospital for ten years and brought out an interesting contrast between typhoid and typhus fevers. His monthly figures for typhoid were as follows: —

J	F	M	A	M	J	J	A	S	O	N	D
113	85	77	60	79	119	157	233	260	253	223	161

By quarters the difference between the two forms of fever, then just beginning to be clearly distinguished, was shown very markedly.

QUARTERLY ADMISSIONS.

	Typhus Fever.	Typhoid Fever.
First Quarter	1074	275
Second "	1088	258
Third "	725	650
Fourth "	619	637

Dr. Tweedie concluded that "typhus is most prevalent in spring, and the least so in autumn, while enteric fever is least prevalent in spring, and most prevalent in autumn." In the same year, Hirsch, in the first edition of the "*Historisch-geographischen Pathologie*,"(92) gave an extensive résumé of current opinion on the subject. He quoted statistics to show that of 519 typhoid epidemics, 168 occurred in autumn, 140 in winter, 132 in summer, and only 79 in spring. He also printed a table of typhoid cases at the hospitals of Lausanne and Geneva, in Lowell and Nassau, and of typhoid deaths in the canton of Geneva and the State of Massachusetts, showing an autumn maximum and a spring minimum in every case. Summer occupied the second place except at Nassau and the canton of Geneva. As to the weather influences controlling this prevalence of the disease he quoted very conflicting opinions. While Drake and Huss attributed the autumnal fever largely to the summer temperature, Davidson and Lombard considered a relatively high humidity as of prime significance. Thomson maintained that both factors were of importance, and Seitz, Cless, and Franque denied any effect of meteorological conditions. Another review of the seasonal variations of typhoid fever was published by Murchison in 1862.(93) He quoted nine English and continental authorities as recording the autumnal maximum, and added a table of the admissions into the London Fever Hospital which showed a steady rise from April to October. Fiedler, in the same year,(94) noted that typhoid fever in Dresden was much more abundant in the second half of the year than in the first, and gave the following table of typhoid admissions for eleven years.

ADMISSIONS TO THE DRESDEN HOSPITAL, 1850–60.

J	F	M	A	M	J	J	A	S	O	N	D
123	76	114	82	83	105	113	191	189	132	143	146

The first systematic attempt to show a relation between typhoid fever and definite meteorological conditions was made by Haller in 1860.[94] This author maintained that the seasonal curve of typhoid corresponded to that of air pressure, and that the greatest prevalence was at periods of low temperature, noting, in that connection, the alleged fact that typhoid fever does not occur autochthonously south of the isotherm of 22° C. Haller's results, however, were not confirmed by other observers; and a new theory as to the ætiology of typhoid fever soon took almost complete possession of the field. This was the famous ground-water theory of Pettenkofer and the Munich school. As applied to typhoid fever this theory was launched by Ludwig Buhl in the first article of the first number of the "*Zeitschrift für Biologie*."[95] The author dealt with eight hundred and ninety-nine typhoid deaths in a Munich hospital during the period 1855–64, and compared, by the graphic method, the monthly and yearly variations with the changes in temperature, precipitation, and ground-water level. The seasonal curve showed a maximum between December and March, culminating in February, and a minimum in August and October. These monthly variations, and the fluctuations from year to year, did not correspond to the temperature or the precipitation, but did show a certain inverse relation to the height of the ground water.

Seidel[96] analyzed the figures given by Buhl in a more elaborate manner. He compared for each of the one hundred and eight months, from 1856 to 1864, the typhoid cases and the ground-water level, using in each case the difference between the value for the individual month and the average value for that month during the whole period. In 73.5 cases an excess of typhoid fever corresponded with an excessive fall of the ground water, and in 34.5 cases the reverse relation obtained. Seidel estimated the probability of this preponderance being due to chance alone as one to thirty-six thousand. His monthly averages for morbidity are as follows:—

Typhoid Cases. Munich Hospital. Average, 1856–64.

J	F	M	A	M	J	J	A	S	O	N	D
14.1	12.0	6.9	5.2	5.2	6.0	4.8	6.8	4.2	7.6	12.2	13.1

In the next year, Seidel[97] analyzed Buhl's figures in relation to the monthly precipitation, again excluding any difference of season per se, by using only the differences between the value for a month and the average value for the same month

during the nine years considered. He demonstrated a certain inverse relation between an excess of precipitation and the prevalence of typhoid fever just as in the case of the variation in ground-water level, and considered both factors as of importance. Of the fifty-six months in which precipitation and ground-water level varied in the same sense, forty-six showed a variation of typhoid morbidity in the opposite sense.

The studies relating to the cases at the Munich Hospital were extended to the whole city by Pettenkofer in 1868.(99) He reproduced a chart prepared by F. Wagus, which gives by months the typhoid mortality for the whole city from 1850 to 1867 in comparison with the precipitation and the height of the ground water. The seasonal distribution of the disease coincided with that observed at the hospital, the average number of typhoid deaths for the whole city being as follows: —

J	F	M	A	M	J	J	A	S	O	N	D
33.5	36.8	31.8	23.1	17.6	15.2	15.8	16.7	16.1	15.0	19.0	28.5

A long series of polemical papers on the relation of typhoid, and more particularly of cholera, to the ground water was contributed by Pettenkofer to the "*Archiv für Hygiene*" and the "*Zeitschrift für Biologie*," and his conclusions were finally summarized in pamphlet form.(115), (118) For a time the theories of the Munich school appeared to hold the field. Virchow (101) studied the typhoid mortality in Berlin for the period 1854–71, and concluded that there was a striking inverse relation with the ground-water level. Virchow and Guttstadt (114) published curves for Berlin from 1883 to 1885, which showed a direct relation to the temperature and an inverse relation to the ground-water level. Finally, a most elaborate presentation of the facts was made by Dr. Soyka in 1887.(117) Like his confrères, this author rested his case in large part on the variations in the intensity of the disease and the height of the ground water from year to year; but he also treated of the seasonal variations at some length. Although his table of the monthly distribution of the disease in seventeen cities, reproduced below, showed an autumnal maximum in all but four cases, he considered that these exceptions, Augsburg, Munich, Prague, and Vienna, proved the temperature relation to be an indirect one.

PERCENTAGE MONTHLY DISTRIBUTION OF TYPHOID.

After Soyka

Place.	Period.	Total No.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
Berlin	1854–85	16660	6.5	6.0	5.4	5.9	5.9	5.6	8.1	11.0	12.6	13.5	10.6	8.2
Neufchatel } Lausanne }	1835–52	933	8.6	5.2	5.5	2.6	4.0	6.1	7.7	10.1	13.4	17.0	9.8	9.4
Breslau	1863–78	2521	7.7	7.5	7.5	6.4	6.1	7.4	8.5	9.6	11.3	10.5	8.7	8.0
Frankfort-a-M.	1853–85	1496	7.9	7.1	6.2	5.6	5.8	6.2	8.4	10.6	11.8	12.1	9.0	8.7
Hanover	1874–85	397	7.6	5.1	6.4	6.1	10.0	7.4	5.0	9.1	12.1	13.6	9.6	8.0
Basel	1826–73	2213	8.6	6.4	6.1	5.4	7.2	7.6	8.4	9.1	10.7	10.7	10.6	8.7
Paris	1867–78	4152	6.2	5.7	4.6	4.9	4.2	4.9	6.9	12.3	13.4	12.5	13.5	10.3
Augsburg	1856–78	1092	11.0	6.7	8.1	5.3	5.1	5.2	7.3	8.9	9.7	9.7	10.6	10.8
Bern	1871–80	340	9.7	6.8	7.3	9.1	6.1	7.3	5.8	6.1	10.0	7.9	12.9	10.6
Munich	1851–85	7530	11.5	11.9	11.2	9.0	7.5	6.9	6.4	6.5	6.3	5.8	6.9	9.6
Prague	1873–84	998	10.5	9.9	10.2	8.5	9.3	9.6	9.8	6.9	7.1	5.0	6.2	6.8
Vienna	1871–85	4992	8.2	7.1	11.8	10.1	9.9	8.0	8.1	7.5	7.3	7.3	6.9	7.7
Basel *	1875–85	3599	10.3	7.1	8.0	6.7	8.0	8.2	10.1	14.8	8.6	6.9	5.7	4.9
Leipzig *	1851–65	1052	9.4	5.7	5.1	4.3	3.8	6.0	9.3	13.0	12.9	13.2	9.4	7.2
Copenhagen *	1842–58	3198	6.1	3.3	3.2	2.8	3.1	5.0	7.9	13.3	18.3	16.4	9.9	10.2
Bremen *	1872–84	1648	7.6	7.0	6.6	4.8	4.9	4.7	8.1	9.6	13.8	16.3	9.1	7.0
Chemnitz *	1838–82	1455	6.2	6.4	7.3	5.2	5.1	6.9	7.4	9.3	13.2	13.2	10.8	8.0
Christiania *	1845–64	4550	11.3	7.3	6.1	4.3	4.0	3.3	6.1	8.8	8.6	9.6	16.8	13.2

* Morbidity. Other figures refer to mortality.

Soyka finally plotted the typhoid fever and ground-water level in Berlin, Frankfort, Bremen, and Munich, and obtained quite regular complementary curves. His final conclusion was that "the rhythm of typhus abdominalis is in general the inverted rhythm of the ground-water fluctuations."

Unfortunately other researches did not harmonize with these results. Socin at Basle [100] and Fodor at Buda-Pesth [110] found quite different relations between typhoid and ground-water level. Later examinations of the yearly variations, even in Munich, failed to show the correspondence noted prior to 1881. Most potent of all, however, in overthrowing the ground-water theory was the gradual substitution of zymotic for miasmatic conceptions of disease which robbed it of any rational ætiological basis.

The only plausible explanation of the connection between ground water and typhoid fever, on the basis of the germ theory, had been furnished by Liebermeister,[98] who suggested in 1860 that the phenomena observed by Buhl might simply be due to the concentration of soil impurities in wells at the time of low water and their transmission in unusually large doses to those who drank therefrom. A simple modification of Liebermeister's idea, including a recognition of the fact that a well in use drains a wider area when the ground water is low and is thus liable to pollution from more distant sources, has been strongly advocated in this country by Dr. H. B. Baker of Michigan. As early as 1878 Dr. Baker [108] published curves showing the

seasonal distribution of the more important diseases, and pointed out the contrast between such diseases as bronchitis, pneumonia, and croup which culminate in the winter and the fevers and diarrhœal diseases which attain a maximum in the hot months. His curves showed a slight rise in October for typhoid fever and much more marked rises for the classes of "Typho-malarial," "Remittent," and "Intermittent" fevers, the figures for which in absolute value greatly exceeded those for the former disease. Similar tables were published in the succeeding annual reports; and in 1882 it was stated that "more than the average per cent of weekly reports stated the presence of typhoid fever in months when the average daily temperature, the average daily range of temperature, the absolute humidity of the atmosphere, the monthly and the average daily range of the barometer and the average daily pressure of the atmosphere were greater than the average for the year; and less than the average per cent of reports stated the presence of typhoid fever in months when these conditions were less than the average for the year." These curves and conclusions have been repeated year by year in each annual report, the only change being the gradual increase of "typhoid fever" relative to the "typho-malarial" and "remittent" fevers with improvement in diagnosis. In 1884, Dr. Baker[(113)] treated typhoid fever in more detail, comparing the seasonal variations of the disease for five years with the height of the ground water in Michigan and showing that the disease increased quite regularly with the number of inches of earth above the water in the wells. He concluded that "in summer when vegetation is active and not decaying, a lowering of the water is uniformly followed by increased prevalence of typhoid fever; with the advent of colder weather there is a rise in the water level which is uniformly followed by a decreased prevalence of the fever; that this decrease continues through the winter and spring even though the level of the well water is lowered, provided the surface of the earth is deeply frozen; that on the contrary high-water level in wells in winter and spring coincident with ground not thoroughly frozen is followed by increased prevalence of the fever."

The relation to ground water was again studied in the Report of the Michigan State Board of Health for 1888 (p. lv.), and 1890 (p. 247); and in the Report for 1894 (p. 300) and succeeding reports, new diagrams were published and the following conclusions were added: "The evidence is conclusive that there is a necessary relation between the low water in wells and the sickness from typhoid fever. The fluctuations in the sickness from typhoid fever and the depth of the water in wells are nearly coincident throughout the several months. The maximum of sickness and the minimum of water are coincident in October." Finally, in 1897, Dr. Baker[(128)]

printed a new diagram exhibiting the curves of typhoid fever and ground water for fourteen years, and suggested in support of his explanation of the inverse relation shown that another factor of less universal importance than the pollution of wells by distant privies might be the infection of air, food, and drink by germs blown from the surface of the ground, which must be dryer and more exposed to such action when the ground water is low.

Dr. Baker's theory regarding the pollution of wells at times of low water seems quite insufficient to account for such a universal phenomenon as the autumnal maximum of typhoid fever, even with the additional suggestion as to air contagion. Well water is by no means the most important source of the disease; and even as to wells the theory does not take all the facts into account. Other observers have attempted to trace with some success an almost exactly opposite relation between typhoid fever and excessive precipitation. Dr. F. H. Welch,[111] for example, who noted that the maximum of typhoid fever occurred in the last quarter of the year in Malta and in Bermuda, in the latter half of the year at Gibraltar, during the autumnal months, — from March to May, — at the Cape of Good Hope, and in the warm season in India, finally concluded that "the great natural assistant (in the spread of the disease) is the rainfall in giving moisture for growth and putrefaction, in causing water circulation on the surface and in the subsoil, in its mechanical removal of material from drains and hidden receptacles."

Whatever the explanation, it seems to be proven that at Munich in the period studied by Pettenkofer and his followers a real relation did exist between ground-water level and typhoid. In no other case, as far as we are aware, has another factor been excluded which normally varies inversely with the ground-water level and which does bear a plausible relation to the distribution of the typhoid germ. This factor is the temperature; and the seasonal curve in many places, Michigan, for example, and Berlin, can be more satisfactorily explained by a direct relation to the temperature than by an inverse relation to the ground-water level. The first author forcibly to call attention to the importance of the temperature factor was Murchison. In the second edition of his work on the continued fevers,[102] he gave a table of the monthly admissions into the London Fever Hospital from 1848 to 1870, of which the totals were as follows: —

J	F	M	A	M	J	J	A	S	O	N	D
433	306	318	209	232	335	434	721	803	839	819	539

Murchison pointed out that a "great increase of enteric fever in the autumn months was observed in each of the twenty-three years, with one noteworthy exception (1860)." He also noted that the autumnal increase did not subside immediately on the advent of winter, and concluded that "it would seem as if the cause of the disease were only exaggerated or called into action by the protracted heat of summer and autumn, and that it required the protracted cold of winter and spring to impair its activity or to destroy it."

He quoted numerous observers, Todd and Burne in England, Stewart in Scotland, Lombard and Rilliet and Barthez in Switzerland, Piedvache, de Claubry and Druher in France, Forget and Quincke in Germany, and Bartlett, Wood, and Flint in the United States, as recording the autumnal character of the disease. Finally he added, "Not only does enteric fever increase in autumn, but it has been found to be unusually prevalent after summers remarkable for their dryness and high temperature, and to be unusually rare in summers and autumns which are cold and wet." The references to the early authorities quoted by Murchison will be found in his elaborate bibliography.

Liebermeister also had a clear conception of the possible effect of temperature upon the prevalence of typhoid fever. In his article on typhoid fever in Ziemssen's Cyclopedia,(103) he plotted the monthly deaths in Berlin and hospital admissions in London and Basle, compared with curves of the monthly variations in temperature, and commented on the results as follows: "The general bearing of these curves is evident. The curves representing the frequency of typhoid correspond to the curves of average temperature, only with this difference. The different points of the typhoid curve follow those of the temperature curve by an interval of some months. The minimum of temperature falls in January, that of typhoid in February or April; the maximum of temperature falls in July, that of typhoid in September and October. It appears, therefore, that the development and spread of typhoid fever is favored by the high summer temperature and checked by the low winter temperature. The interval of two or three months between the temperature and the typhoid curves correspond to the time which is necessary for the changes of temperature to penetrate to the places where the typhoid poison is elaborated, for the development of the poison without the human body, for the period of incubation, and for the time between the commencement of the attack and that of the patient's admission to the hospital, or that of his death."

Cousot,(104) in France, about the same time, noted that the month of October always showed a maximum of typhoid, that the intensity then diminished till spring, and

that the summer was marked by unimportant oscillations. This influence of the season he attributed to the effect of temperature and moisture, and he concluded that a moderate temperature accompanied by humidity furnished the conditions most favorable for the spread of the disease. Further evidence was contributed by Buchan and Mitchell,[106] who tabulated deaths by weeks from all causes distinguished by the Registrar-General in London, for thirty years, 1845–74, and for each disease plotted a curve showing the average weekly deviation from the general weekly mean. For typhoid fever only the six years, 1869–74, were available as prior to 1869 typhus. typhoid and continued fevers were not distinguished. The curve showed a maximum in October and November and a minimum from the middle of May to the end of June, the rise beginning only at the beginning of July, "when the heat of summer has fairly set in."

Pistor,[116] who compared the typhoid cases and deaths for 1883–85 in Berlin, with the height of the ground water and of the river Spree, the precipitation, the height of the barometer, and the temperature of the air and the earth, differed from Virchow and Guttstadt (see above) in finding no marked correspondence with the ground-water variations. As regards temperature, he concluded that "typhoid is in general more abundant in the hot months than in the cold; it appears, however, that mild and damp spring, autumn, and even winter months favor its spread, although not in the same degree as the hot season." Almquist,[119] who studied in detail the seasonal prevalence of fourteen diseases in Göteborg, concluded with regard to typhoid fever that an annual increase in summer or autumn is characteristic, but that this increase is sometimes postponed till the end of the year or the beginning of the next year. A second maximum in January is sometimes combined with the summer maximum. Dryness and the variation in the ground-water level, and above all the warmth in summer and autumn, appeared to him to be operative. Goldberg,[120] in 1889, made an elaborate study of the seasonal prevalence of a large number of diseases in relation to various meteorological conditions, and arrived at the conclusion that the weather influences the mortality from the infectious diseases both by its effect on the multiplication of the germs and their facilities for entrance into the body and by its effect on the vital resistance of the human body in its reaction against the invading organisms. With regard to typhoid fever he analyzed the statistics for Berlin, Hamburg, and Cologne, and summed up his results as follows: —

A. As regards individual disposition, the extremes of air temperature weaken the resistance against typhoid.

B. As regards time-and-place disposition:

1. The rise of typhoid morbidity and mortality in Berlin regularly follows the rise in the temperature of the earth one-half to one meter below the surface.

2. The very different annual periods and annual variations in Berlin, Hamburg, and Cologne correspond throughout to the rhythm of the movements of the ground water.

3. The distribution of rainfall in Berlin and Hamburg, if allowance be made for evaporation, explains satisfactorily the variations both in the height of the ground water and the frequency of typhoid fever.

Goldberg noted what so many other observers have failed to consider that not only the temperature of a given month but also the course of the temperature curve during the months immediately preceding, must be considered; thus the same mean monthly temperature in May and October need not correspond to the same amount of typhoid. He saw that a high temperature favored the spread of typhoid fever, and believed that this was due to a lowering of the vital resistance of the human body by extremes of temperature.

The most important evidence bearing upon the relation of heat to the prevalence of typhoid fever was that collected by Davidson in his "Geographical Pathology," published in 1892.[122] This author strongly emphasized the seasonal character of the disease and considered the temperature to be the one factor of prime importance. He stated that in South Australia, Victoria, and New South Wales typhoid attains its maximum in the autumn months of March, April, and May, and its minimum in September, October, and November. In Queensland the maximum seems to fall upon the hot season, from November to February. For India, he concluded that in the Bengal Presidency the disease attains its maximum in the second quarter and in Central India, Bombay, and Madras in the third quarter. In considering England and Germany, he mentioned the usual autumnal maximum; and for several countries as quoted below, he gave specific figures as to monthly prevalence.

MONTHLY PREVALENCE OF TYPHOID FEVER.

Compiled from figures given by Davidson.

Place.	Period.	Number of Cases.	Monthly Percentage of Total for Year.											
			J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
Finland	1889	639	3.1	4.2	2.8	2.7	5.3	3.1	11.9	20.5	11.7	12.4	13.6	8.6
France (Paris)	1868–78	—	6.2	5.7	4.6	4.9	4.2	4.9	6.9	12.3	13.5	12.5	13.6	10.3
France (Marseilles)	1886-87	—	6.7	4.2	4.4	4.5	6.5	7.0	10.4	14.6	14.6	11.0	8.2	7.8
Italy	three years	—	6.7	6.5	6.8	7.2	7.3	7.2	9.4	11.2	11.1	10.6	8.6	7.4
Norway	1886–87	3138	11.3	7.3	8.9	8.4	5.8	6.1	7.0	8.1	9.5	10.5	8.7	8.4
Scotland (principal towns)	1876–85	3548	8.5	7.7	7.4	7.4	8.8	7.4	5.9	7.4	9.6	11.7	8.7	9.4
Sweden	1886–87	10743	8.9	6.5	6.8	5.9	6.3	5.7	8.1	10.3	11.5	10.0	11.2	8.7

Davidson also attempted to show the causal relation between typhoid fever and temperature variations from year to year after the method adopted by Soyka in treating of the ground-water theory. In the case of New South Wales he took the figures for the period 1877–87, with a mean summer temperature (December to February) of 71.14 F., and a mean typhoid death rate of 5.02 per 10,000, and divided them to form the two following tables.

SIX YEARS WITH TEMPERATURE AND TYPHOID RATE ABOVE THE MEAN FOR THE WHOLE PERIOD.

	1877.	1878.	1882.	1884.	1885.	1886.
Mean Summer Temperature	71.40	72.00	71.17	71.47	71.87	72.10
Mean Typhoid Death Rate	5.96	6.70	5.66	5.86	5.40	6.03

FIVE YEARS WITH TEMPERATURE AND TYPHOID RATE BELOW THE MEAN FOR THE WHOLE PERIOD.

	1879.	1880.	1881.	1883.	1887.
Mean Summer Temperature	71.00	70.17	70.03	70.07	71.10
Mean Typhoid Death Rate	3.84	3.31	3.50	4.76	4.24

Again, in the case of England, Davidson separated from the period 1863–87, four years in which enteric fever was unusually prevalent, and five years which were remarkably free from that disease, and tabulated the relative mean temperatures for those years as follows:—

Four Years with Maximum Typhoid.			Five Years with Minimum Typhoid.		
Year.	Difference between Temperature and Mean Temperature, 1863–87.		Year.	Difference between Temperature and Mean Temperature, 1863–87.	
	For the Year.	For the Third Quarter.		For the Year.	For the Third Quarter.
			1867	–0.7	–0.7
1865	+1.0	+2.1	1877	+0.1	–1.9
1878	+0.3	+0.4	1879	–3.1	–2.3
1880	+0.1	+1.0	1881	–0.6	–0.4
1884	+1.4	+2.3	1885	–0.7	–1.3

These investigations of the yearly variations in typhoid fever are of considerable interest and should be extended; but the differences shown by Davidson are so small and the material so limited as to preclude the drawing of any general conclusions.

The clearest and most definite statement of the effect of temperature upon the spread of typhoid fever that we have seen was made by Professor Woodhead in testifying before the Royal Commission on Metropolitan Water Supply in 1893.[(123)] Having spoken of the importance of spring floods in carrying infection into

water-supplies, he was asked why the maximum of typhoid occurred in autumn instead of at the time of the greatest floods, and his reply was as follows: —

"You were speaking just now of the conditions under which the typhoid bacillus develops, and you were speaking of it as being a pathogenic organism, and therefore as not competing on equal terms with the saprophytic organisms; and here the matter of temperature alone plays such a very important part that it cannot be left out of consideration. Although you have in February the highest point of floods, you have the temperature so low that the typhoid bacillus could scarcely develop under any conditions, whereas when you come to August, when the temperature is much nearer that of the body, that is, the temperature under which the typhoid bacillus can exist, then the conditions become so much more favorable that the organism can live more readily, more easily, and become more virulent outside the body than it can when the temperature is put very much lower, and, therefore, although at flood times the highest flood points one would expect (if you leave out the temperature) the typhoid bacillus to do the greatest amount of damage, still the temperature is so low that the presence of the bacillus is practically a matter of no importance at that period, and it is only when you get to the flood periods when the temperature is higher that you can take these statistics as bearing on the point. But beyond this, should there be a sporadic case of typhoid due to the use of contaminated water, the conditions for the propagation of the disease are not nearly so favorable during the cold months of February as they are in the hotter months of the year, and therefore the health returns and the tables would be much less affected, not only at the time of the primary outbreak but for some little time afterwards."

Plausible as the conclusions of Murchison, Davidson, and Woodhead appear, they have not gained wide acceptance, and in Germany have been utterly ignored, except by Liebermeister in the passage quoted above. In the same year that his statement appeared, Oesterlen [105] published some figures on the quarterly prevalence of typhoid as given below, and concluded: "That temperature exerts no, or at least a very secondary, influence, is obvious from the very small difference which often appears between the different seasons, and from the circumstance that typhoid epidemics may arise and culminate at the extremes of temperature, in great cold as well as great heat."

QUARTERLY PREVALENCE OF TYPHOID.

After Oesterlen.

Place.	Period.	Winter.	Spring.	Summer.	Autumn.
Geneva	—	180	109	105	203
London	1849–53	2813	2527	2916	3305
Nassau	1818–56	670	470	486	863
Massachusetts	1845–49	429	259	528	1132
Lowell	1840–47	130	102	163	250
Berlin (average monthly deaths)	1830–38	27	18	23	41

A little later, Sander[107] gave a table showing the quarterly distribution of typhoid fever in Berlin, Munich, Halle, Hamburg, Schleswig-Holstein, Dresden, Leipsic, and Chemnitz, and stated that the winter in Munich and the autumn in most other places is the period of special incidence, while May and June are always the months which are most exempt. In 1881, Oldendorff[109] published a few figures as to quarterly prevalence, and repeated Oesterlen's conclusion as to the limited importance of the temperature factor.

In the second edition of the "Geographical and Historical Pathology,"[112] Hirsch devoted considerable space to a consideration of the meteorological factors affecting the spread of typhoid fever. He quoted first numerous earlier observers, to whom references are given in his bibliography. Zülzer at Berlin and Trier at Copenhagen thought that hot and dry weather favored the disease, while others held a wet summer to be a contributory cause. Schiefferdecker at Königsberg, Pribram and Popper at Prague, and Jacoby at Breslau believed they had traced a connection between typhoid and the ground-water level. Hirsch then gave the very valuable tables of seasonal prevalence reproduced below, and in comment remarked, "The result obtained from these tables, that the amount of the sickness touches its highest point in autumn, is fully borne out by the facts as to the season of greatest prevalence of typhoid in many other localities." He cited Schwerin, Bremen, Iceland, Malta, Italy, the Cape, Greenland, and Newfoundland; and added, "All the more noteworthy is the circumstance that, in tropical and subtropical regions, it is chiefly the hot months that form the typhoid season," quoting Algiers, Tunis, Japan, India, Cochin China, Bermuda, and Cuba. An analysis of the typhoid statistics of Berlin from 1871 to 1878 failed to show any correspondence between the amount of typhoid in any given year and the excess of temperature compared with the mean for the whole period; and the author concluded his consideration of the subject as follows: "That no special importance in this connection can be ascribed to the temperature of the air — high or low — *by itself*, follows from the fact that the acme of the disease falls variously in various regions within higher latitudes, either in autumn or in winter; while, in the tropics, it falls mostly at the time of the greatest heats."

Monthly Distribution of Typhoid Fever.

After Hirsch.

Place.	Period.	Months.											
		J.	J.	A.	S.	O.	N.	D.	J.	F.	M.	A.	M.
Christiania * .	1845–64	154	281	402	393	437	768	602	517	335	283	196	182
Drammen * . .	1861–67	46	100	149	180	253	251	202	141	92	88	56	55
Copenhagen * .	1842–58	162	254	428	588	526	317	328	195	105	103	92	100
Hamburg . .	1873–80	82	82	122	116	147	127	158	146	149	125	90	102
Berlin . . .	1854–79	850	1159	1616	1879	1965	1540	1184	997	919	854	921	910
Breslau . . .	1863–78	187	215	244	287	267	220	202	197	192	192	164	154
Leipzig * . .	1851–65	64	98	137	135	144	99	76	100	60	54	44	41
Chemnitz * . .	1837–75	171	208	303	300	245	185	241	148	166	121	112	154
Prague * . . .	1874–76	78	90	69	79	76	84	115	191	122	119	106	110
Nassau * . .	1818–59	1118	1406	1742	2093	2350	2207	1946	1850	1584	1428	1060	848
Frankfort-a-M.	1863–80	52	74	91	106	113	93	76	60	58	50	50	43
Stuttgart . .	1852–77	69	76	83	87	88	108	122	106	84	90	73	66
Munich . . .	1852–68 1873–79	408	377	379	365	363	425	619	718	783	699	548	444
Neufchatel Lausanne .	1835–52	57	72	95	125	159	92	88	81	49	52	25	38
Basel . . .	1824–73	169	186	202	237	237	236	193	192	143	137	121	160
London * . .	1848–62	163	220	333	361	377	334	222	197	122	136	89	103
Glasgow * . .	1871–79	12	15	30	43	36	31	20	23	18	29	18	17
Paris	1867–78	205	289	511	559	522	565	429	259	240	192	205	176
Boston * . .	1840–47	30	47	86	92	98	60	48	39	43	40	21	41
Pittsburg . .	1873–77	27	32	65	64	90	65	52	53	37	43	44	53

* Hospital admissions. Other figures refer to reported deaths.

Seasonal Ratio of Typhoid.

After Hirsch.

Place.	Autumn.	Winter.	Summer.	Place.	Autumn.	Winter.	Summer.
Copenhagen . .	4.9	2.1	2.9	Geneva	1.9	1.7	1.0
Drammen . . .	3.4	2.2	1.5	Chemnitz . . .	1.9	1.4	1.8
Lausanne . . .	3.3	1.9	1.9	Basel	1.7	1.3	1.3
London	3.2	1.7	2.2	Glasgow . . .	1.7	.9	.9
Paris	2.9	1.6	1.8	Pittsburg . . .	1.5	1.0	.9
Massachusetts .	2.8	1.3	1.6	Breslau	1.5	1.2	1.3
Leipzig	2.7	1.7	2.1	Sweden	1.2	1.2	1.1
Christiania . . .	2.4	2.2	1.3	Hamburg . . .	1.2	1.3	.9
Boston	2.4	1.2	1.6	Stuttgart . . .	1.2	1.3	1.0
Frankfort-a-M. .	2.2	1.3	1.5	Munich	.7	1.3	.7
Berlin	2.0	1.2	1.4	Prague	.7	1.3	.7
Nassau	2.0	1.6	1.3				

These ratios refer to a value of 1 for the Spring Typhoid. Spring is considered to begin with March.

The work which has been done upon the seasonal prevalence of typhoid fever within the last ten years has, if anything, only made the subject more obscure. Magelssen, in his classic brochure[121] on the dependence of diseases upon the weather, in which he showed so clearly the unfavorable influence of extreme low temperatures upon the general mortality, only alluded to typhoid in passing, stating that it is most abundant in the latter months of the year. Körösi, in 1894,[124] made an elaborate comparison of the reported cases of the infectious diseases in Berlin with the moisture and temperature by periods of five days, a week and a month, according to the incubation period of the disease. He criticised those observers, especially Haller, who have studied the relation of disease to season, in general, on the ground that such a comparison can throw no light on the causation of disease as the phenomena involved are too complex. His method consisted in the division of his pentads and months into five groups, designated as very cold, fairly cold, fairly warm, warm, and hot, and the calculation of the relative prevalence of the disease in each group of periods. He thus eliminated all the effects of the weather preceding the period considered and obscured the facts. When analyzed into his five temperature groups, two maxima appeared, — one in the hot, one in the fairly cold months, — and he concluded that no positive relation is shown. Moisture, on the other hand, appeared to exert an appreciable effect, and he finally concluded that the maximum of morbidity occurred in dry weather with medium warmth, while the minimum was reached when a medium temperature coincided with an excess of moisture. Fodor, in 1896,[125] declared that "the striking dependence on the warmth, and on the season which is so characteristic of cholera is almost entirely wanting in typhoid fever." In the same year, Jessen[126] published curves which showed the monthly prevalence of measles, croup, and diphtheria, typhoid fever, cholera, pneumonia, phthisis, and diarrhoeal diseases of children in comparison with variations in wind, temperature, humidity, and rainfall. With regard to typhoid fever he concluded that temperature was the only factor which affected the disease, and that this was only of slight importance, as typhoid fever, though occurring principally in the cold months (!), sometimes attained a maximum when the temperature was high. Knoevenagel[127] noted the increased prevalence of typhoid fever in Mecklenburg-Schwerin at the end of July and in August and September. Berger[129] and Ruhemann,[130] in 1898, emphasized the importance of atmospheric conditions in ætiology, and criticised the exclusive attention paid to the bacteriological factors in disease. The former author, after an excellent review of literature on the influence of weather on various diseases (tuberculosis, pneumonia), published curves of morbidity from diphtheria, scarlet fever, measles, and typhoid

fever in a rural district for a period of four years. Typhoid fever, although the total number of cases was only twenty-two, showed a maximum in August and a minimum between November and February. Berger concluded that typhoid fever is most prevalent with a falling barometer and a rising thermometer, hygrometer, and dew point, and that its occurrence is favored by damp and cloudy weather. Ruhemann alluded only in passing to typhoid fever, mentioning its summer maximum. Finally, in 1899, Weichselbaum[(131)] concluded that "no seasonal distribution of typhoid, no preference of that disease for any special time of year, at least in the marked sense in which it has been shown for cholera, has been, or will be demonstrated." *

Curschmann, in the latest monograph on typhoid fever,[(132)] notes that this disease shows a "constant and for many countries a uniform relation to the seasons." "Everywhere the increased frequency occurs during the late summer and autumn months." "The period of least prevalence of typhoid fever is everywhere the spring and the beginning of the summer, especially the months of March, April, and May." He quotes the figures for London (Murchison), Dresden (Fiedler), and the Hamburg epidemic of 1886–87, and gives a table for Leipsic which is reproduced below. The London and Leipsic figures, when plotted, show very regular curves.

Cases of Typhoid Fever received into Jacobsspital, Leipsic, from 1880 to 1892.

J	F	M	A	M	J	J	A	S	O	N	D
122	96	97	78	71	75	136	252	240	193	150	88

In commenting on these facts Curschmann says: "The causes for this remarkable uniformity in the relations of typhoid fever to season are as yet wholly unknown.

* Behrens (*Einfluss der Witterung auf Diphtherie, Scharlach, Masern und Typhus*, *Arch. f. Hyg.*, XL., 1901, 1) has recently published an exhaustive study on the influence of weather on the prevalence of diphtheria, scarlet fever, measles, and typhoid. His method consists in the arrangement of the individual months for a period of five years in classes according to temperature, humidity, and precipitation, and the tabulation of the morbidity and mortality for the various classes of months. The cities treated are Carlsruhe, Berlin, Bremen, and Breslau. A series of tables is appended of morbidity in Carlsruhe from the four diseases treated by five-day periods with an elaborate analysis of the meteorological conditions. The results of the investigation are conflicting and inconclusive. With reference to typhoid fever, Dr. Behrens sums up the evidence from his own work and that of Jessen and Körösi as follows: "Typhoid reaches its maximum in hot weather at Carlsruhe, Berlin, and Breslau, in cold weather at Hamburg, and in weather of medium warmth at Budapest. At Bremen no influence of temperature can be shown. Carlsruhe, Berlin, Breslau, and Budapest agree in the fact that the number of typhoid cases is greatest when the humidity is least; in Bremen, on the other hand, the maximum occurs when the hygrometer is highest. A heavy precipitation and a maximum of rainy days favor the disease in all cases." His final conclusion with regard to this disease is as follows: "Typhoid cases are as numerous with a warmer as with a cooler temperature, but are markedly favored in their occurrence by cloudy and rainy weather."

The universality of the relation, its recurrence in all possible, remotely situated regions, indicate that it is dependent not upon local, but upon general conditions, possibly such as are responsible for the power of multiplication and the vital activity of the typhoid germ itself. Although much is known with regard to the details in this connection, an insight into the solution of general questions is wanting, particularly the relation of the poison to important cosmic conditions. It is, therefore, better for the present to leave a glaring deficiency rather than to bridge it over with unstable theories."

II. STATISTICAL STUDIES BY THE AUTHORS ON SEASONAL VARIATIONS IN TEMPERATURE AND ON THE PREVALENCE OF TYPHOID FEVER IN VARIOUS COUNTRIES.

It appears, then, from a review of the literature that, although most observers have noted a characteristic seasonal distribution of typhoid fever, others, including some of those who have written most recently, have denied the existence of such regular variations. Of those who realized that the variations did exist, a few sought an explanation in the factor of temperature. Their views did not, however, gain acceptance, as the evidence furnished was insufficient; and the common view, among medical men and sanitarians, has been that the fall maximum of typhoid fever was an unexplained phenomenon.

The bacteriological work on the effect of low temperatures upon the bacillus of typhoid fever, reported in the first section of this paper, lent force to the idea that the temperature really might in itself exercise a direct effect upon the ætiology of this disease. We therefore determined to see whether the relation shown by Murchison, Liebermeister, and Davidson for a few places could be demonstrated by a more exact examination of statistics collected from a wider field.

We have, accordingly, brought together statistics of the monthly variations in temperature and in the prevalence of typhoid fever for thirty communities, as follows: The States of New York and Massachusetts, the District of Columbia, and the cities of Atlanta, Baltimore, Boston, Charleston, Chicago, Cincinnati, Denver, Mobile, Newark, New Orleans, New York, Oakland, Philadelphia, St. Paul, and San Francisco, in the United States; the city of Montreal in Canada; the cities of Berlin, Dresden, Leipsic, London, Munich, Paris, and Vienna in Europe; the Empire of Japan, and the British Army in India, in Asia; and the cities of Buenos Ayres and Santiago de Chile in South America. Four continents and both hemispheres are thus represented, and a very wide range of climate. (See pp. 540–566.)

The mean monthly temperatures for the American cities were obtained from the reports of the United States Weather Bureau; those for the German cities, from the publications of the astronomical observatories in their respective districts; and those for London, Paris, Montreal, Buenos Ayres, and Santiago from special local publications mentioned in connection with the tables. For the States of New York and Massachusetts, it was assumed that the temperature of New York City and Boston would serve without serious error. For Japan, where the range of temperature is rather wide, an average was taken of the record of ten stations in different parts of the Empire, as given by the Central Meteorological Observatory. In the case of India, it appeared inadvisable to attempt to calculate an average for the whole empire, as the seasons in the different districts are so very different. The typhoid figures are, therefore, compared with two sets of temperature values, for Central India, and for the Punjab, taken from Hann's "*Klimatologie*," which give a fair idea of the two most important meteorological zones. For each of the cities and stations, with one or two exceptions, the figures for ten years have been used in order to secure a reliable average; and the mean monthly temperatures finally obtained have all been reduced to the Fahrenheit scale for uniformity and convenience in plotting the curves.

The typhoid statistics include records of hospital admissions at the two hospitals of Santiago de Chile, of hospital admissions in the British Army in India, of reported cases at Newark and of deaths in all other instances. The figures for the American States and cities, for Montreal, London, and Paris, were obtained from the published reports of the local Departments of Health, supplemented in some cases by information furnished in reply to correspondence; the German statistics were taken from the "*Veröffentlichungen des Kaiserlichen Gesundheitsamtes*;" for Japan, the Annual Reports of the Central Sanitary Bureau, for India, the Parliamentary blue-books, and for the South American cities, local sanitary periodicals referred to in the tables, were consulted. The figures for ten years were averaged in each case except as follows: for Vienna and Japan the period was five years; for Atlanta, six years; for Montreal and New Orleans, eight years; for Denver and Paris, nine years; for the Army in India, eleven years; for Buenos Ayres, twenty-two years. In each case the average number of deaths per month has been reduced to a ratio of one hundred deaths per year, the final figure for each month representing the number that occur in that month for every hundred deaths in the year. Thus the absolute amount of the disease is entirely eliminated, and only its seasonal distribution considered. The value of the statistics will not therefore be impaired by errors of registration, which it may be assumed will not vary from month to month.

Finally, the monthly values for temperature and typhoid prevalence have been plotted on the appended plates in order to show graphically the relation of the two curves. For each locality the abscissæ represent the successive months, and the ordinates the monthly temperature and percentage of annual typhoid. We should not, however, expect the effect of January temperatures to be manifest in the typhoid death-rate until March, as about two months will be taken up in the transfer of the infection to the victim, in the incubation of the disease, and in its course toward a fatal termination. Accordingly, in order to make the relation of the two curves more striking, the typhoid curve has in each case been shifted along to the left by just two months, so that March typhoid comes just above January temperature, and so on. Where cases and not deaths have been considered (Santiago, Newark, India) the curve has been only moved along by one month. This transposition does not, of course, alter the shape of the curves or their relation to each other, but only makes that relation clearer to the eye. (See Plates I.–VIII.)

BOSTON.

Monthly Typhoid Deaths.

From Reports, Local Department of Health.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	7	5	5	11	3	11	11	19	31	42	17	18
1889	6	7	7	7	9	12	17	35	33	23	17	13
1890	7	5	7	7	7	8	9	20	27	20	19	19
1891	8	4	11	9	8	4	7	14	29	29	15	16
1892	2	5	7	7	9	6	6	15	18	29	18	15
1893	13	9	6	10	13	12	7	15	14	26	17	6
1894	3	5	5	7	7	4	4	18	30	27	20	11
1895	8	3	6	7	11	8	9	26	28	26	13	18
1896	14	6	2	5	6	7	8	13	30	34	23	14
1897	14	7	9	11	8	9	10	25	27	22	18	13
Average	8.1	5.6	6.5	8.1	8.1	8.1	8.8	20.0	26.7	27.8	17.7	14.3
Ratio of 100	5.1	3.5	4.1	5.1	5.1	5.1	5.5	12.5	16.7	17.4	11.1	8.9

Mean Monthly Temperature.

From "Monthly Weather Review," U. S. Weather Bureau.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	20	28	32	42	52	67	68	69	59	47	43	34
1889	36	26	38	48	60	69	69	67	63	48	45	38
1890	32	33	35	46	57	64	71	70	63	51	42	26
1891	31	32	34	48	56	65	69	70	67	52	41	40
1892	28	28	33	48	56	70	73	70	62	53	41	30
1893	21	27	34	44	56	65	71	70	60	55	42	30
1894	30	27	42	47	58	69	74	68	65	54	38	32
1895	29	25	35	46	60	67	69	71	66	50	45	36
1896	25	29	32	47	60	66	72	71	62	50	46	30
1897	28	31	37	49	58	62	72	70	63	54	41	34
Average	28	29	35	46	57	66	71	70	63	51	42	33

NEW YORK CITY.

Monthly Typhoid Deaths.

From Reports, State Board of Health.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1887	28	13	21	11	11	16	33	51	53	38	26	22
1888	12	14	13	11	23	11	35	42	82	52	37	33
1889	27	15	21	18	15	19	31	71	57	57	40	21
1890	20	28	13	12	11	11	31	49	64	49	34	29
1891	14	11	17	13	20	23	28	57	65	56	51	29
1892	15	25	17	19	23	23	52	53	57	55	31	30
1893	22	19	29	25	29	23	21	35	42	70	41	26
1894	22	11	17	18	11	14	28	42	57	46	32	28
1895	17	16	8	14	13	23	27	37	46	48	37	36
1896	20	17	11	12	10	13	25	42	38	39	34	36
Average	19.7	16.9	16.7	15.3	16.6	17.6	31.1	47.9	56.1	51.0	36.3	29.0
Ratio of 100	5.6	4.8	4.8	4.2	4.8	5.1	8.7	13.5	15.8	14.4	10.1	8.2

Monthly Temperature.

From "Monthly Weather Review," U. S. Weather Bureau.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D
1888	26	32	32	48	58	71	70	72	63	49	45	34
1889	38	28	41	52	62	70	73	71	66	52	47	41
1890	40	40	37	51	61	70	73	72	67	55	46	31
1891	35	37	38	52	60	70	71	74	70	54	44	42
1892	30	33	35	50	59	72	75	74	66	55	43	31
1893	23	30	36	48	59	69	75	74	64	58	44	35
1894	35	30	44	50	61	71	76	73	70	57	42	37
1895	30	25	36	48	59	70	71	74	70	51	46	37
1896	28	30	32	50	64	66	73	73	65	52	48	32
1897	29	33	39	49	59	65	73	71	65	56	44	36
Average	31	32	37	50	60	69	73	73	67	54	45	36

MASSACHUSETTS.

Average Weekly Typhoid Deaths for each Month.

From Reports, State Board of Health.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1886	6	5	4	5	3	3	4	10	15	16	11	10
1887	4	8	8	7	6	7	5	14	22	16	12	7
1888	6	5	6	7	5	6	5	10	16	26	11	8
1889	6	8	7	5	6	6	7	15	18	16	13	8
1890	6	7	5	4	5	5	4	9	16	14	18	15
1891	15	11	7	7	4	2	4	6	14	15	11	9
1892	6	5	7	4	5	5	6	9	11	37	11	12
1893	9	8	5	6	5	5	4	9	13	17	11	10
1894	5	7	4	5	6	2	4	7	16	15	15	9
1895	4	2	5	6	5	5	5	12	16	12	10	11
Average	6.7	6.6	5.8	5.6	5.0	4.6	4.8	10.1	15.7	18.4	12.3	9.9
Ratio of 100	6.4	6.3	5.5	5.3	4.7	4.4	4.5	9.6	13.9	17.4	11.7	9.4

NEW YORK STATE.

Monthly Typhoid Deaths.

From Reports, State Board of Health.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1887	72	57	72	56	37	54	102	194	248	182	149	104
1888	64	84	81	45	59	45	73	174	279	288	153	138
1889	89	71	69	78	63	45	117	224	247	261	169	117
1890	117	94	72	73	72	69	101	167	234	240	216	157
1891	138	127	121	103	88	90	97	171	287	290	241	183
1892	116	98	96	77	71	75	131	182	282	205	184	147
1893	120	101	115	111	93	83	87	157	227	253	180	158
1894	105	86	131	94	85	72	93	183	229	234	189	139
1895	108	99	99	115	92	81	108	156	220	265	204	169
1896	158	121	103	87	59	66	103	171	221	195	132	126
Average	109	94	96	84	72	68	101	178	247	241	182	144
Ratio of 100	6.7	5.8	5.9	5.2	4.5	4.2	6.3	11.0	15.3	14.9	11.3	8.9

ST. PAUL.

Monthly Typhoid Deaths.

From Reports, Local Board of Health

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	7	8	4	5	6	4	6	14	27	29	22	10
1890	7	4	2	5	0	2	2	17	11	6	6	3
1891	3	6	4	1	2	3	2	6	12	10	7	5
1892	2	1	6	1	0	0	2	1	4	12	7	11
1893	3	2	1	0	2	3	1	11	8	9	5	6
1894	0	1	1	1	0	2	2	4	6	5	6	4
1895	3	5	3	1	1	3	4	5	2	8	1	2
1896	7	6	3	3	1	1	0	5	0	4	5	2
1897	0	2	2	2	1	1	0	1	3	3	6	1
Average	3.6	3.9	2.9	2.1	1.4	2.1	2.1	7.1	8.1	8.4	7.2	4.9
Ratio of 100	6.6	7.2	5.4	3.9	2.7	3.9	3.9	13.2	15.1	15.7	13.4	9.1

Mean Monthly Temperature.

From "Monthly Weather Review," U. S. Weather Bureau.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	–1	12	18	40	50	67	72	66	55	43	33	24
1889	20	10	37	48	56	64	71	70	59	45	29	29
1890	10	18	22	48	52	70	72	65	58	46	36	24
1891	21	11	23	48	58	65	66	67	66	48	26	27
1892	10	21	28	42	51	65	71	69	63	51	28	15
1893	3	9	23	39	54	71	73	69	62	49	30	12
1894	10	14	35	49	58	72	76	72	64	49	27	27
1895	6	11	28	52	59	67	70	70	65	44	31	21
1896	16	21	25	47	63	68	71	70	56	45	22	23
1897	9	19	24	46	57	64	74	66	68	53	29	15
Average	10	15	27	46	56	67	72	68	62	47	29	22

DENVER.

Monthly Typhoid Deaths.

From Reports, Local Department of Health.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	8	1	3	0	2	5	14	22	24	31	21	3
1889	4	0	1	1	4	1	14	23	51	55	22	12
1890	7	5	2	1	9	7	17	31	56	72	50	30
1891	13	9	4	3	2	3	6	11	15	17	9	7
1892	2	1	2	3	2	6	2	12	9	9	15	1
1893	4	4	0	5	8	5	8	4	5	10	15	3
1894	4	2	1	1	3	6	3	8	8	7	48	8
1895	5	1	2	1	2	2	2	5	8	6	8	2
1896	5	0	2	1	4	0	6	13	28	17	12	3
Average	5.8	2.6	1.9	1.8	4.0	3.9	8.0	15.4	22.7	24.9	22.2	7.7
Ratio of 100	4.8	2.1	1.6	1.5	3.3	3.2	6.7	11.9	18.9	20.7	18.5	6.4

Mean Monthly Temperature.

From "Monthly Weather Review," U. S. Weather Bureau.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	27	39	33	53	53	68	71	65	61	48	34	34
1889	27	30	43	51	55	64	72	73	60	52	32	40
1890	28	34	41	48	58	68	72	69	62	49	40	39
1891	25	27	32	48	56	63	70	69	64	52	38	31
1892	26	33	36	46	51	65	72	71	66	50	43	27
1893	38	31	38	45	54	69	73	70	63	51	39	38
1894	31	25	40	50	59	66	72	71	63	54	45	32
1895	28	27	37	50	56	62	67	70	66	51	38	34
1896	37	38	37	50	59	68	72	72	61	50	36	39
1897	27	31	36	47	61	65	70	70	66	51	41	28
Average	29	31	37	49	56	66	71	70	63	51	39	34

MONTREAL.

MONTHLY TYPHOID DEATHS.

From Reports, Local Department of Health.

Year.	J.	F.	M.	A.	M.	J	J.	A.	S.	O.	N.	D.
1888	5	2	4	2	4	4	4	20	24	14	6	5
1889	3	3	2	3	2	2	3	15	19	8	6	6
1891	0	0	8	1	2	2	4	7	13	10	8	7
1892	4	6	3	0	1	2	4	6	8	12	15	4
1893	6	3	2	4	4	3	5	2	6	8	2	5
1894	6	3	4	5	3	0	1	6	6	1	6	1
1895	1	2	1	2	5	2	4	3	10	6	5	3
1896	3	3	2	2	3	1	7	4	4	9	4	4
Average	3.5	2.7	3.2	2.4	3.0	2.0	4.0	7.9	11.2	8.5	6.5	4.4
Ratio of 100	5.9	4.6	5.5	4.0	5.1	3.4	6.7	13.3	18.9	14.3	10.9	7.4

MEAN MONTHLY TEMPERATURE.

From Reports, Local Department of Health.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D
1888	4	12	23	37	54	66	68	64	55	40	33	23
1891	15	19	27	40	52	64	69	65	58	46	32	7
1892	15	17	26	42	52	65	66	67	62	45	35	30
1893	15	18	23	41	53	66	70	66	57	46	33	19
1894	13	13	32	45	56	66	69	63	60	49	30	23
1895	15	14	22	41	58	70	67	66	60	41	34	22
1896	12	15	20	41	58	65	69	67	57	43	35	18
Average	13	15	25	41	55	66	68	65	58	44	33	20

BALTIMORE.

Monthly Typhoid Deaths.

From Reports, Local Department of Health.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	7	8	6	6	5	10	4	26	34	21	17	17
1889	15	7	14	4	12	16	8	30	26	14	19	26
1890	10	12	15	19	13	13	29	36	30	34	25	11
1891	15	8	3	5	9	6	9	14	22	29	17	13
1892	13	9	8	9	11	8	16	30	26	29	21	13
1893	20	5	11	10	4	13	23	33	32	27	34	12
1894	12	8	6	14	14	8	18	39	28	31	21	23
1895	11	11	6	9	7	3	24	12	27	31	19	13
1896	7	11	4	11	11	13	19	23	29	28	22	10
1897	7	8	6	6	6	8	13	36	36	27	19	17
Average	12.7	8.9	7.9	9.3	9.2	9.8	16.3	27.9	29.0	27.1	21.4	15.5
Ratio of 100	6.6	4.6	4.1	4.8	4.8	5.1	8.4	14.4	15.0	14.0	11.1	8.0

Mean Monthly Temperature.

From "Monthly Weather Review," U. S. Weather Bureau.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	29	35	37	53	63	73	74	75	64	51	47	36
1889	39	31	43	55	66	71	77	74	66	54	48	46
1890	44	43	42	54	64	75	75	74	68	57	48	35
1891	38	41	39	56	62	71	72	74	71	55	44	44
1892	32	37	37	52	63	76	76	76	66	56	44	33
1893	25	34	40	53	61	72	77	75	67	57	44	39
1894	37	34	48	52	65	73	78	73	71	57	43	38
1895	31	26	41	53	62	74	73	77	72	53	47	39
1896	34	36	38	57	69	71	78	76	68	55	51	36
1897	32	37	45	53	63	70	77	74	69	58	46	39
Average	34	35	41	54	64	73	76	75	68	55	46	38

LONDON.

Weekly Typhoid Deaths and Average Mean Temperature.

From the Weekly Returns of the Registrar General.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
Deaths . . .	13	14	13	11	12	7	10	9	9	9	9	7	8
Temperature .	38	38	38	39	40	39	40	40	41	41	42	42	45
	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.
Deaths . . .	9	6	8	7	8	7	9	8	8	7	9	9	9
Temperature .	46	46	48	48	50	52	54	56	57	58	59	60	61
	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	38.	39.
Deaths . . .	8	10	7	9	10	9	13	12	19	15	16	17	17
Temperature .	62	63	63	62	62	63	62	61	60	59	58	56	55
	40.	41.	42.	43.	44.	45.	46.	47.	48.	49.	50	51.	52.
Deaths . . .	17	19	19	18	20	19	19	20	17	16	19	15	16
Temperature .	53	51	49	47	47	45	42	41	41	41	40	39	38

Weekly typhoid rate is average for ten years, 1888–1897. Temperature is average for years, 1840–1890.

Average Weekly Typhoid Deaths for each Month.

	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
Deaths	13.0	9.0	8.0	7.0	8.0	8.0	8.0	16.0	16.0	18.0	19.0	16.0
Ratio of 100 . . .	8.9	6.2	5.5	4.8	5.5	5.5	5.5	11.0	11.0	12.3	13.0	11.0
Temperature . . .	38.0	40.0	42.0	47.0	53.0	59.0	62.0	62.0	57.0	50.0	43.0	40.0

LEIPSIC.

Monthly Typhoid Deaths.

From "Veröffentlichungen des Kaiserlichen Gesundheitsamtes."

	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	1	2	1	1	1	3	2	1	1	0	4	2
1889	2	2	2	2	1	0	4	6	6	6	3	2
1890	6	1	1	0	1	5	2	7	6	4	3	6
1891	5	5	4	6	5	1	6	5	6	4	3	4
1892	0	3	1	0	1	1	4	3	4	7	3	2
1893	2	2	0	0	0	3	4	1	6	2	1	6
1894	1	2	2	1	5	5	4	3	2	4	5	4
1895	0	3	1	1	2	2	0	3	8	5	6	2
1896	2	3	2	5	1	1	1	3	2	2	3	7
1897	3	5	3	1	2	1	2	5	8	3	4	0
Average	2.2	2.8	1.7	1.7	1.9	2.2	2.9	3.7	4.9	3.7	3.5	3.5
Ratio of 100	6.3	8.1	4.9	4.9	5.5	6.3	8.4	10.7	14.1	10.7	10.1	10.1

Mean Monthly Temperature. 1864–1890.

From "Amtliche Publication des Königl. sächsischen meteorologischen Institutes. Das Klima des Königreiches Sachsen." Heft III, 1895.

	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
Centigrade	−1	0	3	8	13	17	18	17	14	8	3	0
Fahrenheit	30	32	37	46	55	63	64	63	57	46	37	32

BERLIN.

Monthly Typhoid Deaths.

From "Veröffentlichungen des Kaiserlichen Gesundheitsamtes."

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	38	19	10	11	8	10	18	22	13	15	11	13
1889	11	21	58	23	14	11	28	20	23	18	36	27
1890	14	15	11	9	10	8	10	16	18	18	9	5
1891	9	7	16	7	9	9	7	20	19	31	20	12
1892	12	6	15	7	10	10	7	9	23	15	10	13
1893	7	6	11	8	13	8	7	19	42	16	18	5
1894	7	9	8	7	7	5	7	5	10	10	5	12
1895	6	7	8	2	4	14	8	16	22	17	8	14
1896	9	6	6	11	8	6	11	14	17	11	4	5
1897	3	1	8	8	5	4	4	20	11	10	7	9
Average	11.6	9.7	15.1	9.3	8.8	8.5	10.7	16.1	19.8	16.1	12.8	11.5
Ratio of 100	8.0	6.7	10.0	6.0	6.0	5.3	7.3	10.7	13.3	10.7	8.7	7.3

Mean Monthly Temperature.

From "Ergebnisse der meteorologischen Beobachtungen von dem Königlich. Preussischen meteorologischen Institut."

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	−1	−2	0	7	14	17	17	17	15	8	4	2
1889	−2	−1	1	9	19	22	18	17	13	9	4	0
1890	3	−1	6	9	16	16	18	19	15	9	4	−4
1891	−3	1	4	6	15	16	18	17	16	11	4	3
1892	−1	1	2	8	13	17	18	20	16	9	2	−1
1893	−7	2	5	9	13	17	19	18	13	11	3	1
1894	−1	3	6	11	13	16	20	17	12	9	5	1
Average	−2	0	3	8	15	17	18	18	14	9	4	0
Fahrenheit	28	32	37	46	59	63	64	64	57	48	39	32

EMPIRE OF JAPAN.

Monthly Typhoid Deaths.

From Annual Reports of the Central Sanitary Bureau of Japan.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1890	568	386	380	402	540	527	603	838	1159	1309	977	775
1891	556	285	264	392	724	1038	1028	940	1255	1286	1009	837
1892	541	382	366	405	468	628	734	938	1165	1252	921	729
1893	508	361	368	340	450	520	646	827	1190	1262	1016	695
1894	515	319	226	256	338	515	681	1068	1298	1141	995	702
Average	538	347	321	359	504	646	738	922	1203	1250	984	748
Ratio of 100	6.3	4.1	3.8	4.2	5.9	7.5	8.6	10.8	14.1	14.6	11.5	8.8

Mean Monthly Temperature. (10 stations.) (3–6 years.)

From "The Climate of Japan," Central Meteorological Observatory, Tokio, 1893.

Stations.	J	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
Kumamoto	3	7	10	16	19	22	26	27	25	18	12	8
Matsuyama	4	6	8	13	17	21	25	26	23	17	12	9
Hiroshima .	3	5	8	13	19	22	25	27	23	17	11	7
Ozaka . .	4	5	9	14	18	22	26	27	24	17	12	7
Wakayama	5	5	9	14	18	22	26	27	23	17	12	8
Nagano .	–2	0	4	11	14	19	23	24	20	12	7	4
Tokio . .	3	4	7	13	16	21	24	26	22	16	11	6
Hakodate .	–4	–2	3	7	11	14	18	21	18	11	5	1
Sapporo .	–7	–5	0	5	11	15	19	21	17	9	3	–1
Nemuro .	–6	–5	–1	4	7	10	15	18	16	10	4	0
Average .	0	2	6	11	15	19	23	24	21	14	9	5
Fahrenheit	32	36	43	52	59	66	74	75	70	58	48	41

SAN FRANCISCO.

Monthly Typhoid Deaths.

From Reports, Local Department of Health.

Year.	J.	F.	M.	A.	M.	J.	J	A.	S.	O.	N.	D.
1888							12	10	18	13	15	12
1889	6	10	8	13	12	9						
1890	17	6	7	6	4	17	17	13	11	21	14	10
1891	13	6	10	5	9	8	18	16	7	8	11	12
1892	8	6	8	4	4	1	13	14	5	13	11	7
1893	4	5	3	4	3	12	10	11	10	9	16	10
1894	11	7	5	5	9	6	8	13	12	9	10	20
1895	14	11	4	6	5	11	16	5	12	8	7	9
1896	10	6	6	5	7	10	0	8	7	10	7	9
1897	13	2	7	5	3	4	3	4	—	5	4	4
Average	10.7	6.7	6.4	5.9	6.2	8.7	10.8	10.4	10.2	10.7	10.6	10.3
Ratio of 100	9.9	6.1	6.0	5.5	5.8	8.1	10.0	9.7	9.4	9.9	9.8	9.6

Mean Monthly Temperature.

From "Monthly Weather Review," U. S. Weather Bureau.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	46	53	52	56	55	61	59	58	59	59	55	52
1889	50	54	57	59	59	60	59	60	65	62	59	51
1890	46	49	54	55	60	59	60	61	60	62	59	50
1891	52	51	55	53	56	60	59	62	62	60	59	50
1892	52	52	54	53	58	57	58	59	60	60	57	51
1893	47	50	51	52	56	56	57	57	59	58	56	52
1894	48	48	51	55	55	56	56	59	63	60	59	50
1895	49	54	52	55	58	59	58	58	61	59	56	49
1896	52	55	54	52	56	57	59	59	60	59	53	53
1897	49	51	49	57	57	59	58	58	61	58	53	51
Average	49	52	53	55	56	58	58	59	61	60	57	51

CINCINNATI.

Monthly Typhoid Deaths.

From Reports, Local Department of Health.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	41	34	16	11	6	7	6	12	17	16	22	15
1889	11	14	11	19	7	9	12	14	14	11	12	9
1890	18	11	17	9	14	14	23	24	20	23	23	9
1891	10	17	14	21	14	21	10	16	7	22	22	12
1892	17	10	8	4	4	7	6	10	12	9	11	23
1893	10	14	8	4	14	6	8	15	14	12	12	17
1894	18	11	15	10	10	8	12	6	10	21	11	37
1895	22	12	7	6	5	5	7	7	8	10	8	23
1896	34	22	15	11	11	5	6	14	9	11	11	15
1897	9	8	5	5	10	3	17	9	9	9	6	11
Average	19.0	15.3	12.6	10.0	9.5	8.5	10.7	12.7	12.0	14.4	13.8	17.1
Ratio of 100	12.3	9.9	8.2	6.5	6.2	5.5	6.9	8.2	7.8	9.4	8.9	11.1

Mean Monthly Temperature.

From "Monthly Weather Review," U. S. Weather Bureau.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	29	35	39	55	63	74	76	73	63	50	45	36
1889	37	30	46	54	63	70	75	72	66	52	43	48
1890	41	43	40	56	64	78	77	73	66	56	48	36
1891	36	40	38	56	60	74	71	72	70	55	43	42
1892	26	39	38	53	62	75	76	75	68	56	40	32
1893	21	34	42	54	61	73	79	75	70	56	42	36
1894	38	33	49	54	63	75	77	77	72	57	41	37
1895	27	24	41	55	64	76	75	77	73	51	44	37
1896	34	35	37	62	71	73	76	75	65	53	48	38
1897	29	36	46	52	59	72	78	74	71	63	46	36
Average	32	35	42	55	63	74	76	74	68	55	44	38

DISTRICT OF COLUMBIA.

Monthly Typhoid Deaths.

From Reports, Local Department of Health.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1887							18	32	22	20	18	15
1888	8	7	8	7	3	10	12	23	27	34	19	7
1889	14	7	9	5	6	7	23	18	29	15	18	29
1890	9	6	19	11	10	21	33	26	29	30	21	17
1891	12	6	12	9	5	8	6	22	21	36	26	12
1892	13	13	8	7	8	11	19	21	30	22	25	18
1893	6	7	6	11	11	10	21	24	28	23	23	21
1894	10	5	5	6	5	20	33	30	26	30	24	16
1895	3	8	1	1	1	1	12	27	56	55	24	20
1896	9	8	3	3	4	7	8	15	25	25	18	16
1897	13	4	4	4	6	9						
Average	9.7	7.1	7.5	6.4	5.9	10.4	18.5	23.8	29.3	29.0	21.6	17.1
Ratio of 100	5.2	3.8	4.1	3.5	3.2	5.6	10.0	12.9	15.8	15.7	11.7	9.2

Mean Monthly Temperature.

From Reports, Local Department of Health.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O	N.	D.
1887							80.5	73.2	65.0	55.4	44.9	37.2
1888	29.2	35.7	37.5	52.9	62.7	73.0	72.9	73.9	63.2	50.5	45.8	35.2
1889	36.8	29.4	42.3	53.2	63.8	69.8	74.2	70.6	65.6	52.5	46.2	45.6
1890	44.2	43.4	41.4	53.7	63.8	74.9	75.1	73.5	67.7	56.2	47.8	34.2
1891	37.3	41.5	38.5	55.4	61.3	71.4	72.0	74.5	79.2	54.4	43.9	43.1
1892	31.7	36.9	37.7	51.5	63.8	76.2	75.7	76.2	66.2	55.0	43.6	33.0
1893	24.0	34.9	41.0	54.0	61.6	72.0	77.0	74.7	66.0	56.4	43.6	38.4
1894	37.7	35.2	48.6	53.2	64.8	73.7	78.0	73.9	71.4	57.8	43.8	37.4
1895	31.6	26.2	41.8	53.8	62.6	74.6	72.7	77.3	72.4	52.1	46.4	38.7
1896	33.3	36.6	38.6	66.5	68.8	71.3	76.6	75.7	67.7	54.0	50.6	35.5
1897	30.9	36.5	46.0	53.0	62.5	69.7						
Average	34	36	41	55	64	73	75	74	68	54	46	38

MOBILE.

Monthly Typhoid Deaths.

Obtained, in correspondence, by courtesy of Local Department of Health.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1889	0	0	2	2	0	2	2	3	1	1	1	2
1890	0	2	0	1	1	2	6	2	0	1	0	1
1891	0	0	0	0	2	0	3	0	4	3	2	0
1892	0	1	0	0	1	1	4	3	1	2	0	1
1893	1	1	1	1	0	4	3	1	2	2	0	0
1894	1	2	0	0	1	2	4	1	1	1	1	1
1895	3	0	0	0	2	1	2	3	4	4	1	2
1896	1	0	0	0	2	1	5	1	0	2	3	1
1897	1	1	0	0	1	3	4	2	5	1	2	0
1898	1	0	2	1	1	2	6	4	2	2	1	1
Average	.8	.7	.5	.5	1.1	1.8	3.9	2.0	2.0	1.9	1.1	.9
Ratio of 100	4.6	4.1	2.9	2.9	6.4	10.4	22.6	11.6	11.6	11.0	6.4	5.2

Mean Monthly Temperature.

From "Monthly Weather Review," U. S. Weather Bureau.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1889	51	51	59	68	70	77	81	79	77	66	56	61
1890	62	61	57	68	73	80	80	80	77	67	61	54
1891	49	59	59	66	72	80	80	80	77	65	57	53
1892	47	57	55	66	72	79	79	80	75	69	58	52
1893	46	58	57	69	74	79	82	81	78	66	58	55
1894	55	53	60	69	74	78	79	80	78	68	57	54
1895	49	43	58	66	72	79	81	81	81	65	58	50
1896	49	53	57	69	76	79	81	82	77	68	62	51
1897	48	55	66	66	71	81	82	80	78	71	60	54
1898	55	53	63	62	75	80	81	80	78	65	56	49
Average	51	54	59	67	73	79	81	80	78	67	58	53

OAKLAND.

Monthly Typhoid Deaths.

Obtained, in correspondence, by courtesy of Local Department of Health.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1889	1	1	4	2	2	0	0	1	1	3	3	1
1890	2	0	5	1	0	1	2	1	2	3	2	3
1891	0	0	0	2	2	1	3	4	6	2	3	3
1892	0	2	1	2	3	1	1	2	0	5	1	2
1893	0	2	0	0	1	4	22	4	7	2	3	1
1894	1	2	3	1	0	1	2	2	0	1	0	1
1895	2	3	0	3	2	0	3	1	2	0	1	1
1896	1	3	1	0	1	2	0	0	2	3	3	2
1897	1	1	0	0	1	0	1	0	2	1	1	1
1898	0	0	0	0	2	1	3	2	1	1	1	1
Average	0.8	1.4	1.4	1.1	1.4	1.1	3.7	1.7	2.3	2.1	1.8	1.6
Ratio of 100	3.9	6.9	6.9	5.4	6.9	5.4	18.1	8.3	11.3	10.3	8.8	7.8

Mean Monthly Temperature.

From "Monthly Weather Review," U. S. Weather Bureau.

Year	J.	F.	M.	A.	M.	J.	J.	A.	S.	O	N.	D.
1889	48	50	57	59	59	61	60	61	63	61	57	50
1890	44	48	54	55	60	59	62	62	61	62	57	49
1891	51	49	53	53	55	60	61	63	62	59	57	49
1892	52	50	53	53	58	62	64	64	63	58	53	49
1893	49	51	54	56	58	62	62	61	62	58	54	51
1894	45	48	52	57	59	61	59	61	62	59	56	49
1895	47	52	51	56	59	60	63	59	62	56	54	47
1896	51	53	55	54	58	61	64	63	—	58	51	49
1897	46	49	49	59	61	64	63	61	63	58	51	47
1898	44	51	51	57	57	64	62	62	61	60	53	47
Average	48	50	53	56	58	61	62	62	62	59	54	49

DRESDEN.

Monthly Typhoid Deaths.

From " Veröffentlichungen des Kaiserlichen Gesundheitsamtes."

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	4	2	2	1	1	0	0	6	4	1	2	3
1889	4	2	0	1	3	1	2	4	1	2	1	0
1890	1	3	4	0	1	1	1	2	1	3	3	2
1891	3	1	3	1	2	2	2	3	3	0	5	2
1892	0	0	4	1	0	1	2	1	1	3	1	2
1893	1	0	1	3	1	0	0	0	1	1	3	2
1894	0	0	1	8	3	2	1	3	5	1	2	0
1895	1	1	0	0	2	1	4	3	1	1	2	1
1896	0	0	0	4	2	2	1	1	0	1	1	3
1897	0	0	1	1	1	0	3	0	2	1	2	1
Average	1.4	.9	1.6	2.0	1.6	1.0	1.6	2.3	1.9	1.4	2.2	1.6
Ratio of 100	7.2	4.6	8.2	10.3	8.2	5.1	8.2	11.8	9.7	7.2	11.3	8.2

Mean Monthly Temperature. Average 1864–1890.

From "Amtliche Publication des Königl. sächsischen meteorologischen Institutes. Das Klima des Königreiches Sachsen." Heft III, 1895.

	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
Centigrade	0	1	3	8	13	16	18	17	14	9	4	0
Fahrenheit	32	34	37	46	55	61	64	63	57	48	39	32

MUNICH.

Monthly Typhoid Deaths.

From "Veröffentlichungen des Kaiserlichen Gesundheitsamtes."

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	4	1	5	3	3	4	3	0	2	2	2	2
1889	3	2	2	2	3	2	6	1	1	6	2	1
1890	2	1	3	2	2	0	2	4	2	5	4	1
1891	2	3	3	3	2	3	1	1	1	3	0	2
1892	2	1	0	0	1	3	0	1	2	0	1	0
1893	3	3	0	1	1	20	15	9	1	3	1	0
1894	0	0	1	2	0	1	3	0	2	0	0	1
1895	1	2	1	0	0	1	0	2	3	1	0	4
1896	2	2	0	1	1	0	1	3	0	2	1	1
1897	0	0	0	2	1	7	7	5	1	0	0	0
Average	1.9	1.5	1.5	1.6	1.4	4.1	3.8	2.6	1.5	2.2	1.1	1.2
Ratio of 100	7.8	6.1	6.1	6.6	5.7	16.7	15.6	10.7	6.1	9.0	4.5	4.9

Mean Monthly Temperature.

From "Beobachtungen der meteorologischen Stationen im Königreich Bayern."

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1889	−4	−3	−1	7	15	18	17	16	11	8	1	−4
1890	1	−5	3	7	14	14	16	17	12	6	2	−7
1891	−6	−3	3	5	13	16	17	15	13	9	1	−7
1892	−2	1	1	7	13	16	16	19	14	7	3	−3
1893	−9	2	4	9	12	16	18	17	13	9	1	−3
1894	−5	1	4	10	11	14	18	16	11	8	3	−1
1895	−5	−8	1	8	11	15	18	17	16	7	5	0
Average	−4	−2	2	8	13	16	17	17	13	8	2	−3
Fahrenheit	25	28	36	46	55	61	63	63	55	46	36	27

VIENNA.

Monthly Typhoid Deaths.

From "Veröffentlichungen des Kaiserlichen Gesundheitsamtes."

Year.	J.	F.	M	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	7	7	12	8	7	9	4	4	5	9	5	26
1889	18	14	9	9	12	5	5	5	5	9	2	8
1890	6	7	7	7	6	6	4	6	11	7	3	7
1894	7	5	8	5	8	10	3	12	2	5	4	5
1895	5	3	2	2	5	6	13	12	6	11	14	7
Average	8.6	7.2	7.6	6.2	7.6	7.2	5.8	7.8	5.8	8.2	5.6	10.6
Ratio of 100	9.8	8.2	8.6	7.0	8.6	8.2	6.6	8.8	6.6	9.3	6.3	12.0

Mean Monthly Temperature.

From "Jahrbücher der k. k. Central-Anstalt für Meteorologie und Erdmagnetismus."

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	–3	–3	4	8	15	18	18	18	15	8	2	0
1889	–2	–1	1	9	18	20	19	18	12	11	3	–4
1890	1	–2	6	9	16	16	19	21	14	9	4	–5
1891	–6	–2	4	7	16	17	18	17	16	12	3	1
1892	–1	1	2	10	14	17	19	21	16	9	2	–2
1893	–8	2	6	10	14	17	19	19	15	11	3	1
1894	–3	2	8	15	17	18	23	20	16	12	5	1
Average	–3	0	4	10	16	18	19	19	15	10	3	–1
Fahrenheit	27	32	39	50	61	64	66	66	59	50	37	30

CHICAGO.

Monthly Typhoid Deaths.

From Reports, Local Department of Health.

Year.	J.	F.	M.	A.	M.	J.	J	A.	S.	O.	N.	D
1889	30	21	15	12	16	18	29	64	77	68	68	35
1890	53	136	103	45	82	107	86	115	95	72	67	47
1891	67	61	71	136	408	167	200	182	198	171	150	186
1892	311	187	76	56	70	55	211	179	138	92	67	47
1893	41	30	41	58	56	60	55	76	86	81	43	43
1894	46	26	27	30	31	31	37	52	71	68	38	34
1895	30	21	26	30	30	18	36	59	76	90	60	42
1896	87	89	65	33	31	44	58	64	87	89	60	44
1897	38	46	41	19	13	23	27	42	48	61	44	35
1898	29	32	41	94	67	35	55	45	65	62	56	55
Average	75	59	51	51	80	56	79	88	94	85	65	57
Ratio of 100	8.8	7.0	6.0	6.0	9.5	6.7	9.4	10.5	11.2	10.1	7.7	6.8

Mean Monthly Temperature.

From "Monthly Weather Review," U. S. Weather Bureau.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	15	23	30	45	53	67	72	69	60	48	41	31
1889	29	20	38	47	57	62	70	71	63	49	39	41
1890	31	32	29	46	53	70	72	68	60	51	42	31
1891	30	29	31	47	53	66	67	69	69	53	34	35
1892	19	30	31	44	52	64	72	71	64	54	35	23
1893	12	21	33	44	52	68	74	70	64	53	36	25
1894	27	23	41	47	56	71	73	71	66	52	34	32
1895	18	17	32	46	59	70	70	72	69	46	36	30
1896	27	27	31	53	65	67	72	73	61	50	38	33
1897	22	29	35	46	55	65	74	69	69	58	39	25
Average	23	25	33	46	55	67	72	70	64	51	37	32

PHILADELPHIA.

Monthly Typhoid Deaths.

From Reports, Local Department of Health.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	63	46	40	37	84	49	62	169	100	67	36	32
1889	62	79	61	41	64	50	68	83	70	63	33	66
1890	126	54	52	52	51	36	56	62	57	47	39	34
1891	50	44	102	141	76	42	49	42	53	35	23	26
1892	51	68	51	37	30	24	20	40	44	37	11	27
1893	43	34	38	35	61	37	26	47	47	29	25	35
1894	43	18	20	25	36	24	29	50	34	31	29	31
1895	36	64	48	40	39	38	33	36	32	43	30	30
1896	34	23	21	40	46	27	31	38	34	17	28	63
1897	36	18	27	41	50	32	25	49	24	20	31	48
Average	54	45	46	49	54	36	40	62	49	39	28	39
Ratio of 100	10.0	8.2	8.4	9.0	10.0	6.7	7.4	11.5	9.0	7.2	5.2	7.2

Mean Monthly Temperature.

From "Monthly Weather Review," U. S. Weather Bureau.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	28	34	35	51	61	73	72	74	64	50	46	36
1889	39	29	42	53	65	71	75	73	66	53	47	44
1890	42	41	39	52	63	74	75	74	67	55	46	32
1891	36	40	38	54	61	72	72	74	72	55	44	43
1892	31	35	36	51	62	74	77	76	67	56	44	33
1893	24	32	39	51	61	72	77	76	66	58	44	36
1894	37	32	47	51	64	73	78	73	70	57	42	37
1895	31	25	38	52	62	74	73	77	72	53	47	39
1896	31	34	36	55	67	70	78	77	68	54	50	35
1897	31	36	43	53	63	69	76	74	68	58	46	38
Average	33	34	39	52	63	72	75	75	68	55	46	37

NEWARK.

Monthly Typhoid Cases.

From Report of Local Department of Health for 1899.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1890	93	23	21	17	16	7	20	10	22	27	34	57
1891	88	42	43	18	18	11	15	167	207	137	92	38
1892	36	27	19	11	4	4	16	32	30	17	16	17
1893	5	3	9	6	8	10	11	26	12	21	7	7
1894	2	4	6	9	6	3	3	10	13	21	6	5
1895	2	3	2	1	6	4	4	31	38	21	21	15
1896	10	5	3	2	3	6	4	14	25	29	7	8
1897	5	5	11	7	5	2	8	7	14	11	13	15
1898	5	3	2	3	3	7	6	38	59	29	16	8
1899	2	2	301	67	27	9	19	28	30	12	10	8
Average	24.8	11.7	41.7	14.1	9.6	6.3	10.6	36.3	45.0	32.5	22.2	17.8
Ratio of 100	9.2	4.3	15.4	5.2	3.6	2.3	3.9	13.4	16.7	12.0	8.2	6.6

Mean Monthly Temperature.

From "Monthly Weather Review," U. S. Weather Bureau.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1890	39	38	36	49	60	71	73	72	65	54	43	30
1891	33	36	36	51	59	69	70	72	69	53	43	41
1892	30	34	34	49	59	72	74	73	64	54	41	30
1893	22	28	35	47	59	68	74	73	62	55	41	34
1894	33	28	43	49	60	70	75	71	67	54	40	35
1895	29	25	36	48	61	71	71	74	70	50	45	37
1896	29	31	33	53	66	69	76	75	66	53	49	32
1897	30	33	40	50	62	67	75	72	66	55	44	35
1898	33	33	45	48	58	71	76	76	70	56	43	32
1899	29	25	36	49	61	72	74	72	64	56	43	34
Average	31	31	37	49	60	70	74	73	66	54	43	34

PARIS.

Monthly Typhoid Deaths.

From "Annuaire statistique de la ville de Paris."

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	146	78	52	58	54	52	81	51	70	65	69	71
1889	69	62	57	43	53	71	102	153	120	92	84	208
1890	74	39	45	47	51	57	44	54	76	92	71	73
1891	65	59	53	47	36	30	37	43	40	39	54	46
1892	50	36	48	37	48	78	90	89	97	105	62	59
1893	48	49	50	47	29	29	63	73	72	48	33	29
1894	25	53	289	84	34	46	33	37	21	22	29	24
1895	11	9	13	21	13	25	22	30	43	34	24	26
1896	35	17	21	10	25	9	30	35	26	17	28	9
Average	52	40	63	39	34	40	50	56	56	51	45	54
Ratio of 100	9.0	6.9	10.9	6.7	5.9	6.9	8.6	9.7	9.7	8.8	7.7	9.3

Mean Monthly Temperature.

From "Annuaire statistique de la ville de Paris."

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	1	0	4	7	13	16	16	16	15	8	8	3
1889	1	2	4	9	15	19	18	17	14	10	6	0
1890	6	2	6	9	14	15	16	17	15	9	6	−3
1891	−1	3	6	8	12	16	17	16	15	12	5	5
1892	2	4	4	10	15	17	18	19	15	9	8	1
1893	−1	6	9	14	14	18	19	20	15	11	5	3
1894	3	5	8	12	12	16	18	17	14	10	7	4
1895	0	−4	5	11	14	16	18	18	19	9	9	5
1896	2	3	9	9	13	17	19	16	15	9	3	4
Average	1	2	5	9	13	16	17	17	15	9	6	2
Fahrenheit	34	36	41	48	55	61	63	63	59	48	43	36

NEW ORLEANS.

Monthly Typhoid Deaths.

From Reports, Local Department of Health.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1886	5	3	0	0	2	3	4	3	3	3	1	3
1887	2	4	0	1	3	4	1	4	2	4	2	7
1890	7	6	3	2	3	6	7	4	2	3	1	6
1891	5	1	1	1	3	6	7	6	10	2	4	13
1892	4	1	1	2	2	6	3	10	10	2	5	5
1893	2	2	5	1	1	6	4	1	4	4	4	5
1896	7	2	7	8	4	12	9	14	8	4	4	11
1897	10	4	3	7	6	16	21	18	10	11	19	16
Average	5.2	2.9	2.5	2.7	3.0	7.4	7.0	7.5	6.1	4.1	5.0	8.2
Ratio of 100	8.5	4.7	4.0	4.5	4.9	11.9	11.3	12.2	9.9	6.7	8.1	13.4

Mean Monthly Temperature.

From "Monthly Weather Review," U. S. Weather Bureau.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	56	59	60	70	73	77	81	78	75	68	59	51
1889	53	53	61	70	74	78	83	81	79	70	59	64
1890	65	64	62	70	74	81	82	81	78	69	64	56
1891	53	63	61	68	74	81	81	81	78	68	60	56
1892	49	61	59	69	74	79	80	82	77	71	62	56
1893	50	61	61	72	76	80	83	82	80	69	60	58
1894	58	55	63	71	75	78	79	80	80	71	60	58
1895	52	45	62	68	74	80	82	82	82	69	60	54
1896	52	56	61	71	78	80	83	83	79	70	65	55
1897	51	58	69	68	74	82	84	82	79	74	64	57
Average	54	57	62	70	75	80	82	81	79	70	61	56

ATLANTA.

Monthly Typhoid Deaths.

Obtained, in correspondence, by courtesy of Local Board of Health.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D
1893	1	1	3	3	4	5	11	13	7	9	5	1
1894	0	0	1	1	3	6	11	12	7	6	2	1
1895	0	0	3	0	1	3	4	12	14	20	6	5
1896	3	2	4	2	3	7	13	8	10	8	5	3
1897	1	0	0	1	0	10	10	11	9	6	4	3
1898	4	3	1	4	4	5	5	8	8	7	5	2
Average	1.5	1.0	2.0	1.8	2.5	6.0	9.0	10.7	9.2	9.3	4.5	2.5
Ratio of 100	2.5	1.7	3.3	3.0	4.2	10.0	15.0	17.8	15.3	15.5	7.5	4.2

Monthly Temperature.

From "Monthly Weather Review," U. S. Weather Bureau.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1893	36	46	51	64	67	74	81	77	73	62	51	47
1894	47	45	57	62	69	76	76	76	73	62	49	46
1895	40	34	51	60	67	77	77	77	76	60	52	44
1896	42	45	49	66	75	75	78	80	75	61	56	44
1897	39	48	55	60	68	79	78	76	74	66	53	45
1898	47	43	57	56	73	79	78	77	74	60	49	44
Average	42	43	53	61	70	77	78	77	74	62	52	45

CHARLESTON.

Monthly Typhoid Deaths.

From Reports, Local Department of Health.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	3	3	1	0	1	2	2	7	4	5	4	4
1889	3	2	2	4	1	4	3	5	3	5	3	5
1890	4	6	3	2	2	6	6	8	4	9	2	4
1891	5	2	1	0	0	1	6	3	3	5	2	0
1892	5	1	2	1	4	0	3	3	3	3	1	1
1893	1	4	2	0	2	1	4	2	4	3	1	0
1894	1	2	2	2	1	4	1	2	4	4	2	0
1895	1	0	2	1	2	2	10	3	2	5	3	2
1896	3	5	3	3	2	6	4	5	4	3	1	5
1897	1	2	2	4	0	3	5	5	7	1	3	7
Average	2.7	2.7	2.0	1.7	1.5	2.9	4.4	4.3	3.8	4.3	2.2	2.8
Ratio of 100	7.6	7.6	5.7	4.8	4.2	8.2	12.5	12.2	10.8	12.2	6.2	7.9

Mean Monthly Temperature.

From "Monthly Weather Review," U. S. Weather Bureau.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1888	51	54	55	66	72	78	78	80	74	64	56	47
1889	52	47	55	63	74	77	81	78	76	65	60	60
1890	59	61	56	65	73	82	80	80	76	68	62	51
1891	50	58	55	65	70	80	80	80	76	68	62	55
1892	48	53	55	64	72	80	80	81	76	64	56	55
1893	43	56	56	68	72	78	80	81	75	66	57	52
1894	53	53	61	65	72	78	83	79	78	68	58	54
1895	49	41	56	64	72	77	79	80	78	68	57	52
1896	48	52	55	66	70	79	81	82	78	66	58	51
1897	47	55	61	66	77	79	82	81	77	67	63	49
					72	80	82	81	75	70	62	54
Average	50	53	57	65	72	79	81	80	76	67	59	53

EMPIRE OF INDIA.

Monthly Typhoid Admissions, British Troops in India.

From Report on Sanitary Measures in India in 1896–97. Vol. XXX.

Period.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1886–95 1896	518 65	418 75	689 202	1427 214	1795 160	1365 152	1441 175	1718 214	1400 179	923 90	745 92	879 177
Total	583	493	891	1641	1955	1517	1616	1932	1579	1013	837	1056
Average Ratio of 100	53 3.9	45 3.3	81 5.9	149 10.9	178 13.0	138 10.1	147 10.7	175 12.8	144 10.5	92 6.7	76 5.5	96 7.0

Monthly Range of Temperature.

From "Handbuch der Klimatologie," J. Hann. Zweite Auflage. Stuttgart, 1897.

Difference between the monthly mean and the yearly mean. Central India, Deccan, 20.8° N., 78.0° E., 390 M.

J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
–6	–3	2	6	8	3	0	0	0	0	–4	–7

Punjab, 31.1° N., 72.3° E., 200 M.

J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
–12	–10	–3	3	7	10	9	7	6	0	–7	–11

SANTIAGO DE CHILE.

Typhoid cases received at Hospital S. Francisco de Borja and Hospital S. Juan de Dios, 1886–1895.

Figures from essay, "La Fiebre Tifoidea en Santiago," by Pedro V. Garcia, P., "Revista Chilena de Hijiene." Tomo III, Núm. 11.

	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
Total	121	121	102	87	65	49	52	47	49	60	73	107
Ratio of 100	13.0	13.0	11.0	9.4	7.0	5.3	5.6	5.1	5.3	6.5	7.8	11.5

Mean Monthly Temperature.

From "Observaciones meteorolójicas hechas en el Observatorio Astronómico de Santiago."

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1882	20.7	18.9	16.4	12.6	10.3	8.0	7.4	9.5	12.4	15.2	16.6	18.4
1883	19.1	18.9	15.3	12.8	9.9	7.5	6.8	8.9	10.8	13.3	16.2	18.9
1884	21.7	18.2	15.3	13.3	9.0	7.0	6.4	10.3	10.9	13.2	16.4	19.0
1885	18.7	18.3	16.4	10.3	8.8	7.5	6.4	9.4	12.6	13.5	18.0	17.4
1886	19.9	18.1	16.5	13.4	10.2	6.2	8.1	8.7	11.5	14.4	16.5	19.4
1887	19.8	18.4	16.4	13.1	9.7	8.5	8.6	10.5	11.7	13.4	16.0	18.1
Average	20	18	16	13	10	7	7	9	12	14	16	18
Fahrenheit	68	64	61	55	50	45	45	48	54	57	61	64

BUENOS AYRES.

Monthly Typhoid Deaths, 1876–1897.

	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
Total	573	534	632	728	642	487	317	284	233	262	317	432
Ratio of 100	10.4	9.8	11.6	13.4	11.8	9.0	5.8	5.2	4.3	4.8	5.8	7.9

Mean Monthly Temperature, 1876–1897.

Figures from essay, "La Fiebre Tifoidea en Buenos Aires," by Dr. Diego T. R. Davison, "Anales del Departamento Nacional de Hijiene." Año VIII. Núm. 13.

	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
Centigrade	23.5	22.8	21.2	16.7	13.2	10.3	10.4	11.5	13.3	16.1	19.8	22.4
Fahrenheit	73	73	70	63	55	50	50	53	55	61	68	72

III. INTERPRETATION OF THE STATISTICAL RESULTS.

An examination of the curves plotted as above described shows that a very striking parallelism exists between the monthly variations in temperature and typhoid prevalence. Of the thirty communities considered, eighteen show this parallelism to be almost perfect; these are the Empire of Japan, the States of New York and Massachusetts, the District of Columbia, and the cities of Atlanta, Baltimore, Berlin, Boston, Buenos Ayres, Denver, Leipsic, London, Mobile, Montreal, New York, St. Paul, San Francisco, and Santiago. Three other typhoid curves — those for India, for Charleston, and for New Orleans — rise with the temperature in spring, and fall with it in autumn, but show a temporary decrease in the disease during the time of greatest heat. In all these twenty-one cases the connection between the two factors seems too close not to indicate a vital relation. In the northern cities — Montreal, Boston, Denver, and St. Paul — the curve of typhoid is acute; in cities with a more and more equable temperature the curve of the disease is progressively flattened, the limit being reached in the case of San Francisco. In the northerly localities the maximum occurs in September and October; in the southern cities, with a milder winter, it comes in August (Atlanta) or July (Charleston and Mobile). In the two cities of the southern hemisphere the curves of both typhoid fever and temperature are exactly reversed. In the case of the tropical and sub-tropical regions — India, Charleston, and New Orleans — it appears that the rise with the temperature, after beginning in the usual fashion, is checked by some other factor, perhaps strong sunlight or extreme dryness. (See Plates I.–VIII.)

It remains now to consider the nine cities which show more or less irregular curves, and to see if their abnormalities are capable of explanation. These nine cities are Chicago, Cincinnati, Dresden, Munich, Newark, Oakland, Paris, Philadelphia, and Vienna. The first thing to notice in this connection, and the one all previous students of seasonal variation have neglected is the necessity of discriminating between sharp epidemic outbreaks of the disease and the slow succession of isolated cases which characterize that condition known to the older sanitarians as "endemic." The term endemic has been so misused and has become so associated with the idea of a mysterious miasm inherent in a geographical region, that it cannot be safely used in a more scientific sense. At the same time a distinction, vital to the epidemiologist, must be drawn between the infection which reaches a number of persons at once through a single medium as water or milk, and the slower, more complex process by which a disease passes from person to person through a population, the path of the

contagious material being different in each individual instance. For this sort of infection which spreads gradually in a community instead of striking a large number of persons at a single blow, the term "prosodemic," meaning "through" or "among" the people, has been suggested.

In the examination of data bearing on the question of the seasonal prevalence of typhoid fever it is obviously the prosodemic disease which should be mainly considered. Cases of this sort furnish a large number of independent facts which may be averaged together fairly; while an epidemic must always be a perturbing element. Thus, for example, a public water supply furnishes exceptional facilities for the distribution of infection from its watershed to a large number of individuals. Twelve hundred cases of typhoid fever at Plymouth, Pa., derived from a single house on the banks of a reservoir have, for a study of normal seasonal variations, far less significance than fifty cases, in which the paths of infection are separate and independent.

Curves of seasonal variation which are based on a small number of cases will always be liable to show irregularities due to single epidemics; and if our tables of typhoid deaths be inspected, it will at once be seen that four of the nine exceptions to a regular seasonal distribution are due to this cause. Thus the form of the Oakland curve is distorted by the epidemic of twenty-two deaths in July, 1893, which we are informed by the local authorities was due to an infection of the milk supply. The largest number of deaths in any other month in the ten years was seven, so that this irregularity could not be compensated. Similarly, the Munich curve owes its peculiarity to the epidemic of thirty-five deaths in June and July of 1893, the largest number in any other month being nine. The curve for Vienna is controlled, in a similar way, by an epidemic in December, 1888, and January and February, 1889. In all these cases the curve would follow the temperature more or less normally if these perturbations were eliminated. Again for Dresden the total number of deaths is so small that eight cases in April, 1894, cause a notable distortion. That the typhoid in this city did follow the temperature when there was enough of it to give average results is shown by Fiedler's figures for 1850–60, quoted above.

We may thus consider that the irregularities of the Oakland, Munich, Vienna, and Dresden curves are explained by the fact that the number of cases considered is too small to eliminate the haphazard effect of epidemics. There remain to be explained the exceptions offered by Chicago, Cincinnati, Newark, Paris, and Philadelphia, in all of which cities the amount of material is amply sufficient to prevent mere chance irregularities. If the curves for these five cities be compared, it will at once be noted that they exhibit a remarkable resemblance. Besides the summer rise, each curve

exhibits two secondary maxima, one in December or January, the other between March and May. If our general theory be correct, there must in these localities be some special condition tending to produce typhoid epidemics in the early winter and the early spring, which modifies the normal influence of the season. Fortunately, we know exactly what this influence is. These five cities — and of the thirty communities we have considered, these five only — draw their water supply from surface sources liable to gross pollution. The epidemics of March, 1899, at Newark; of May, 1891, at Chicago; of January, 1888, and December, 1889, at Paris, as well as the lesser winter and spring outbreaks in other years, were unquestionably due to the public water supplies of those cities. We have here then a special condition influencing the occurrence of epidemics in cities having surface water supplies and therefore deranging the normal course of prosodemic typhoid. The heavy autumn rains and the spring floods consequent on the melting of the winter's snow, carry into surface water supplies a larger amount of pollution than reaches them at any other time, — as is well shown by a comparison of the bacterial content of surface water at various seasons. We may venture to generalize by saying that winter and spring epidemics are characteristic of those cities whose water-supply is most subject to pollution; they are absent from communities which use filtered water or water obtained from adequately protected watersheds.

Finally, then, it appears that of the thirty communities we have studied, all but four, in which the number of cases is too small to furnish average results, give typhoid curves corresponding to one of three types, — the normal temperature distribution, the subtropical modification, and the modification due to winter and spring water-epidemics. These latter types of distribution are explicable as the resultant of a combination of the temperature factor with another. We may therefore conclude that wherever a sufficient number of cases has been considered a direct relation between typhoid fever and temperature appears to be general and invariable.

IV. CONCLUSION OF THE AUTHORS THAT THE SEASONAL PREVALENCE OF TYPHOID FEVER DEPENDS MAINLY UPON SEASONAL TEMPERATURE.

The increase of typhoid fever with a gradual rise in the mean air temperature of a given locality appears to be a phenomenon so widespread and significant as to indicate beyond reasonable doubt some relation between the two factors. Whether this relation be direct or indirect must be determined by considerations as to the ætiology of the disease and as to the relation of temperature to the various vehicles mainly concerned in its transmission.

The methods by which prosodemic typhoid may spread are almost innumerable. The last link in the chain is, in most cases, some article of food or drink, and the food becomes infected, in many instances, from the fingers of a typhoid patient or of his unprofessional attendants. The transmission of typhoid fever on a large scale by water and milk has led sanitarians to minimize unduly this direct personal element in its ætiology. In a well-organized, thoroughly sanitary city dwelling the distinction between contagion and infection is an important one; but in dirty surroundings typhoid becomes, for all practical purposes, a contagious disease. This fact, in itself, throws some little light on its seasonal prevalence. A large number of persons who live ordinarily in cities, surrounded by many sanitary safeguards, in vacation time are exposed in camps and summer resorts to abundant opportunities for filth infection. The autumn fever, in small part at least, occurs among those who are attacked on such summer vacations or immediately after their return home.

Again, several special sources of food contamination have a more potent influence at this season of the year. Those observers are perhaps correct who consider that ground waters are most dangerous when the wells are at their lowest and liable to receive impurities from a wide area. Professor Gualdi would explain the facts by attaching great significance to raw vegetables as vehicles for the transmission of typhoid fever; and he has traced out a more or less close connection between the consumption of these articles and the amount of typhoid in Rome. Most original of all is the suggestion of Bonne, who seeks to explain the autumnal maximum at Hamburg by the increased amount of bathing in the Elbe beginning with the July heat.

Of the three great intermediaries of typhoid transmission, fingers, food, and flies, the last is even more significant than the others in relation to seasonal variation. Since the emphasis laid on this vehicle of infection by the surgeons who studied the conditions of the late Spanish War, our conception of its importance has grown more and more considerable. There can be little doubt that many of the so-called "sporadic" cases of typhoid fever which are so difficult for the sanitarian to explain are conditioned by the passage of a fly from an infected vault to an unprotected table or an open larder. The relation of this factor to the season is of course close and complete; and a certain amount of the autumnal excess of fever is undoubtedly traceable to the presence of large numbers of flies and to the opportunities for their pernicious activity.

None of the factors noted, however, nor the whole of them taken together, seem to us to account satisfactorily for the observed phenomena. Neither the agency of insects, nor the exposure of urban subjects to rural unsanitary conditions, though both are undoubtedly important, can be held to account for a phenomenon so con-

stant, so striking, and so universal. The parallelism between the curves of typhoid and of temperature is too close not to suggest in the strongest manner some direct relation such as was postulated by Murchison, Liebermeister, and Davidson. No one doubts a direct correlation between the growth in a wheat-field and the changes of temperature during the changing seasons. The fundamental properties of protoplasm are so constant that there seems no reason to doubt a similar favorable effect of the warmth of summer, not on the crop of typhoid plants growing in human bodies, but on the survival seed which passes from one body to another through the environment. This is theoretical; but the experiments reported in the first section of this paper furnish practical evidence to confirm the *à priori* hypothesis that it must be more difficult for an organism habituated to a temperature of 98° F. to persist in Nature when the thermometer is at 30° than when it is in the neighborhood of 80°.

We do not wish to assert that the typhoid bacillus multiplies in the environment during the summer months of a temperate climate. It is the absence of the destructive influence of cold, rather than any stimulating influence of heat, which permits the rise culminating in the autumnal maximum.

In fine, the probable mechanism of the seasonal changes according to our conception is as follows: —

The bacteriology and the ætiology of typhoid fever both indicate that its causal agents cannot be abundant in the environment during the colder season of the year. The germs of the disease are carried over the winter in the bodies of a few patients and perhaps in vaults or other deposits of organic matter where they are protected from the severity of the season. The number of persons who receive infection from the discharge of these winter cases will depend, other things being equal, upon the length of time for which the bacteria cast in these discharges into the environment, remain alive and virulent. The length of the period during which the microbes live will depend largely upon the general temperature; as the season grows milder, more and more of each crop of germs sent at random into the outer world will survive long enough to gain entry to a human being and bear fruit. The process will be cumulative. Each case will cause more secondary cases; and each of the latter will have a still more extensive opportunity for widespread damage. In our opinion the most reasonable explanation of the seasonal variations of typhoid fever is a direct effect of temperature upon the persistence in Nature of germs which proceed from previous victims of the disease.

PART III.

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EXPLANATION OF THE PLATES.

Plates I.–VIII. are based upon the statistics given on pp. 540–566, as is stated on p. 539. Abscissæ indicate months; ordinates indicate temperatures (shown by broken lines), and also percentages of yearly typhoid-fever mortality (solid lines) except in the curves for Newark, N. J. (Plate VI.), the Empire of India (Plate VII.), and Santiago de Chile (Plate V.), in which deaths, not cases, are indicated.

It is important to remember that the curve of typhoid deaths in each case has been moved back exactly two months from its true position, and that for typhoid cases one month, as is explained on p. 539.

PLATE I.

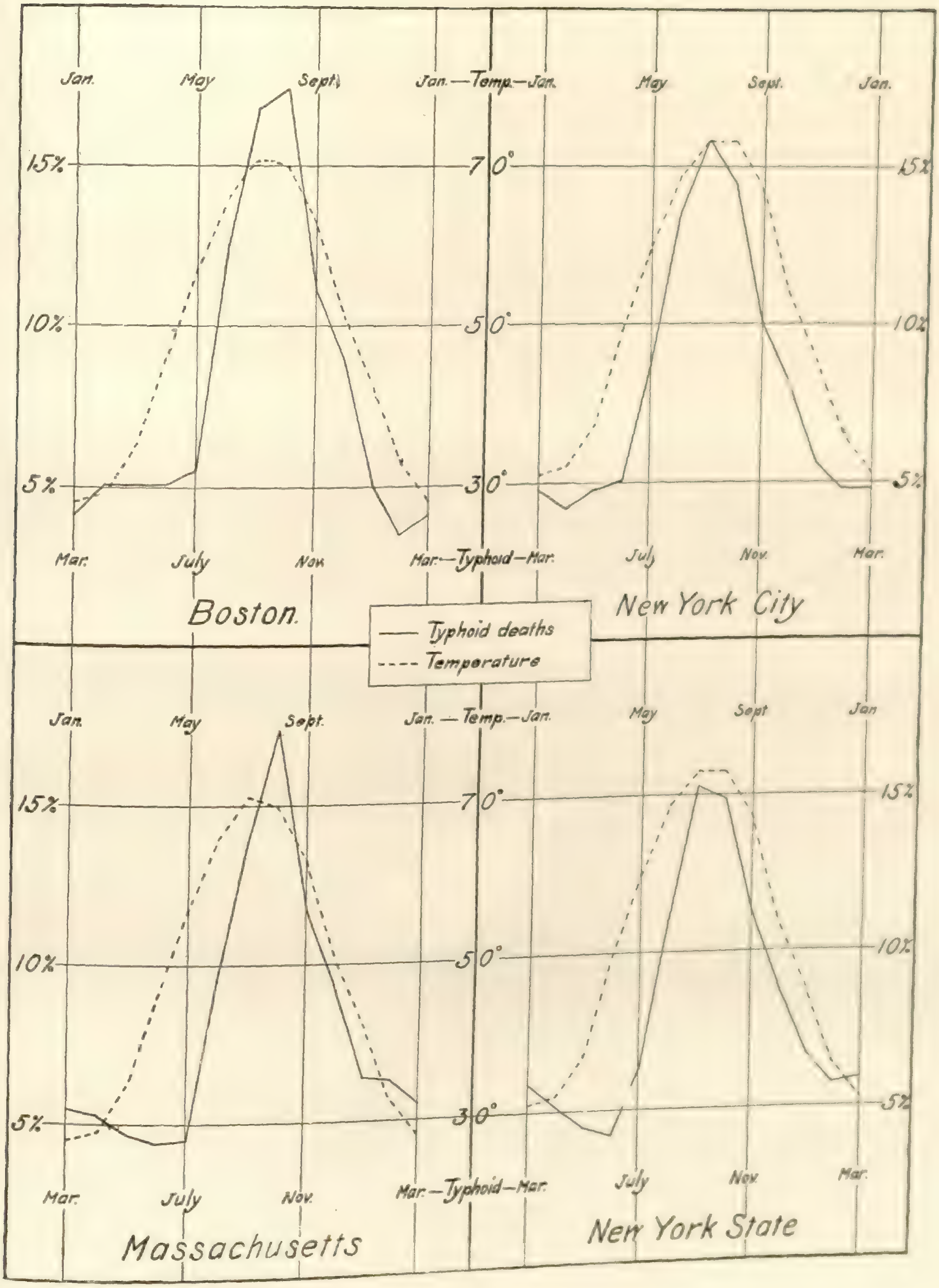
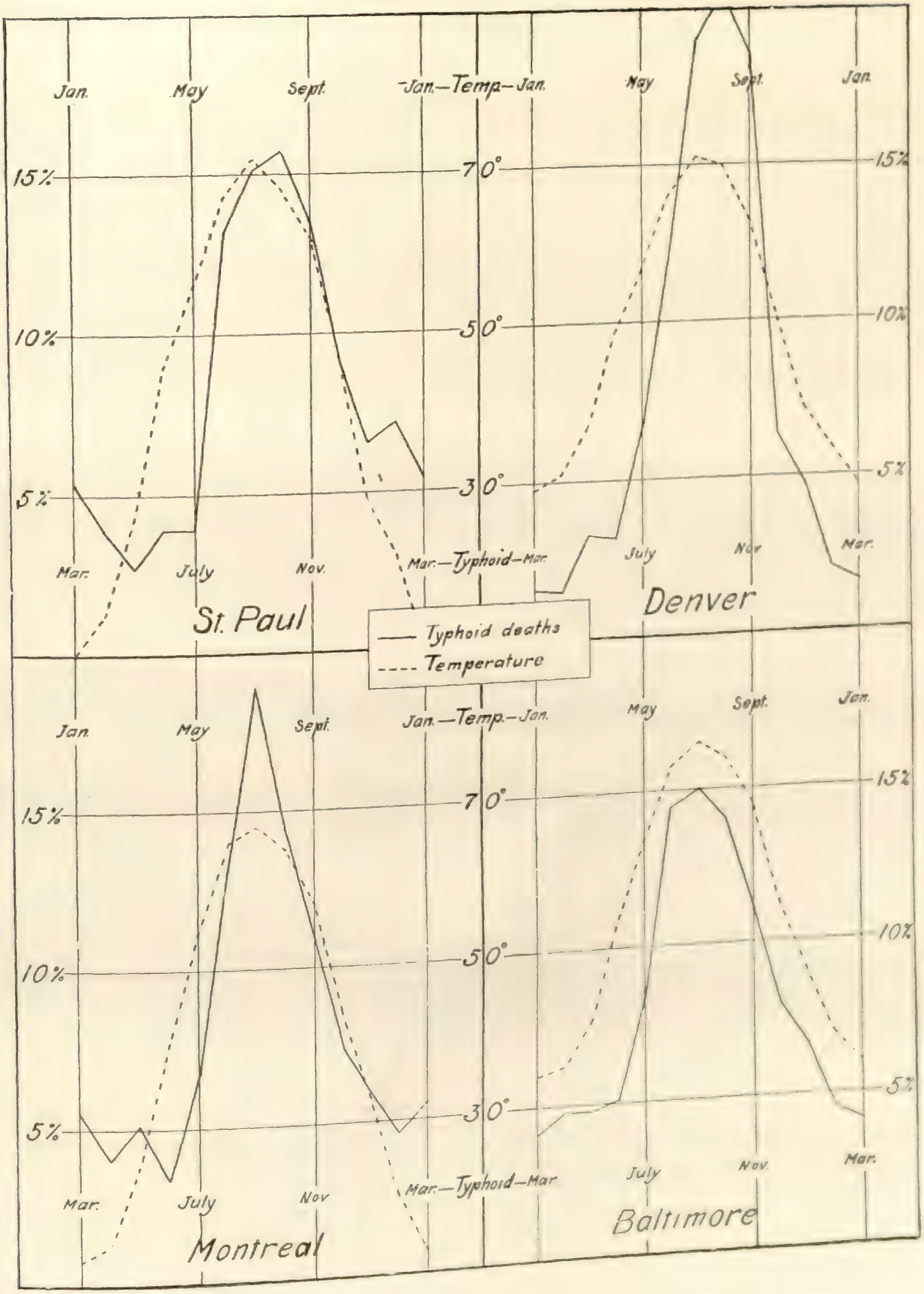
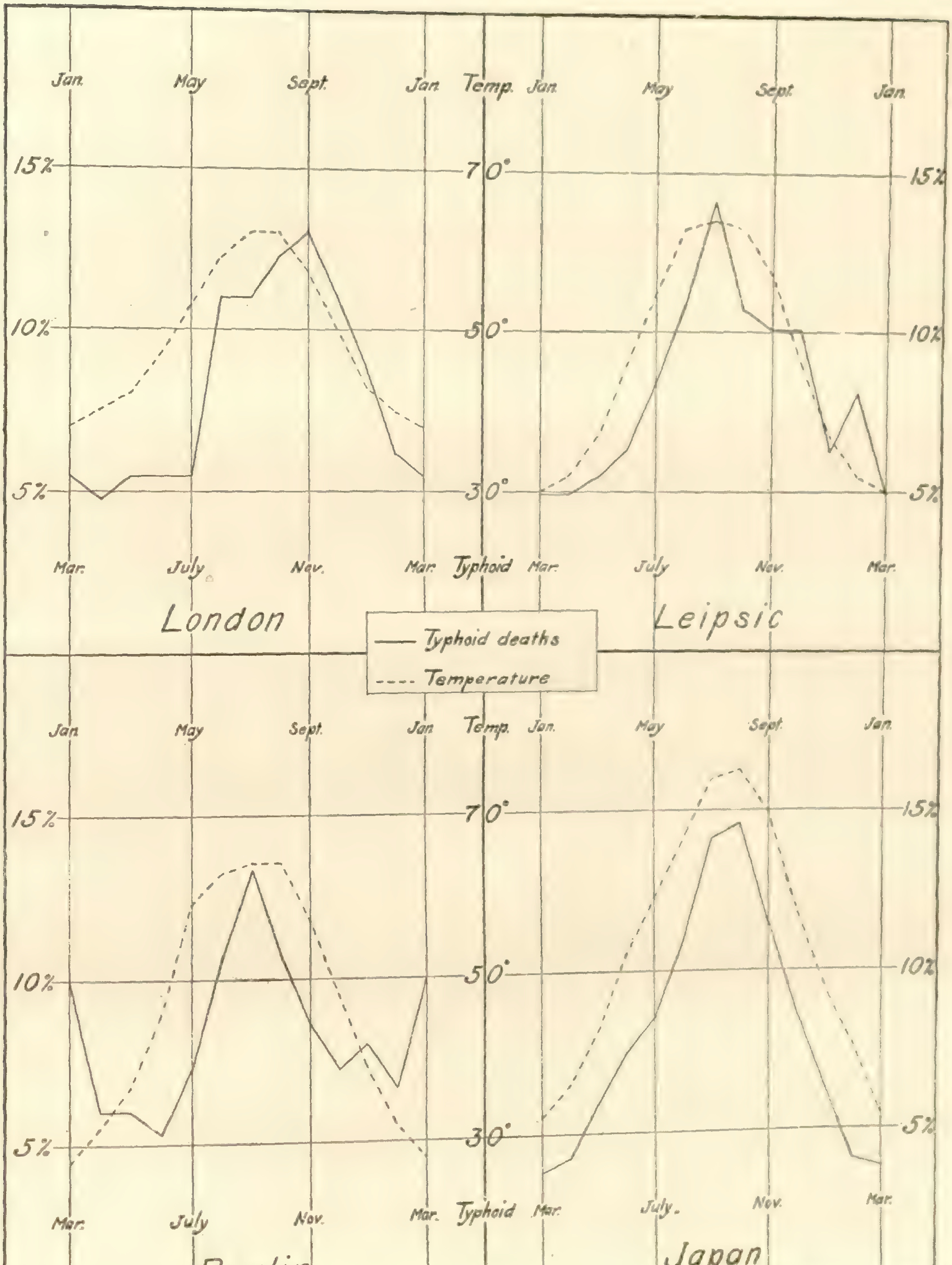

Jan.
May
Sept.
Jan.—Temp.—Jan.
May
Sept.
Jan.
15%
70°
15%
10%
50°
10%
5%
30°
5%
Mar.
July
Nov.
Mar.—Typhoid—Mar.
July
Nov.
Mar.
Boston.
New York City
— Typhoid deaths
---- Temperature
Jan.
May
Sept.
Jan. —Temp.—Jan.
May
Sept
Jan
15%
70°
15%
10%
50°
10%
5%
30°
5%
Mar.
July
Nov.
Mar.—Typhoid—Mar.
July
Nov.
Mar.
Massachusetts
New York State

PLATE II.



Jan.
May
Sept.
Jan.—Temp.—Jan.
May
Sept.
Jan.
15%
70°
15%
10%
50°
10%
5%
30°
5%
Mar.
July
Nov.
Mar.—Typhoid—Mar.
July
Nov
Mar.
St. Paul
Denver
Typhoid deaths
Temperature
Jan.
May
Sept.
Jan.—Temp.—Jan.
May
Sept.
Jan.
15%
70°
15%
10%
50°
10%
5%
30°
5%
Mar.
July
Nov
Mar.—Typhoid—Mar
July
Nov.
Mar.
Montreal
Baltimore

PLATE III.



Jan.
May
Sept.
Jan.
Temp.
Jan.
May
Sept.
Jan.
15%
7 0°
15%
10%
5 0°
10%
5%
3 0°
5%
Mar.
July
Nov.
Mar.
Typhoid
Mar.
July
Nov.
Mar.
London
Leipsic
Typhoid deaths
Temperature
Jan.
May
Sept.
Jan.
Temp.
Jan.
May
Sept.
Jan.
15%
7 0°
15%
10%
5 0°
10%
5%
3 0°
5%
Mar.
July
Nov.
Mar.
Typhoid
Mar.
July.
Nov.
Mar.
Berlin
Japan

PLATE IV.

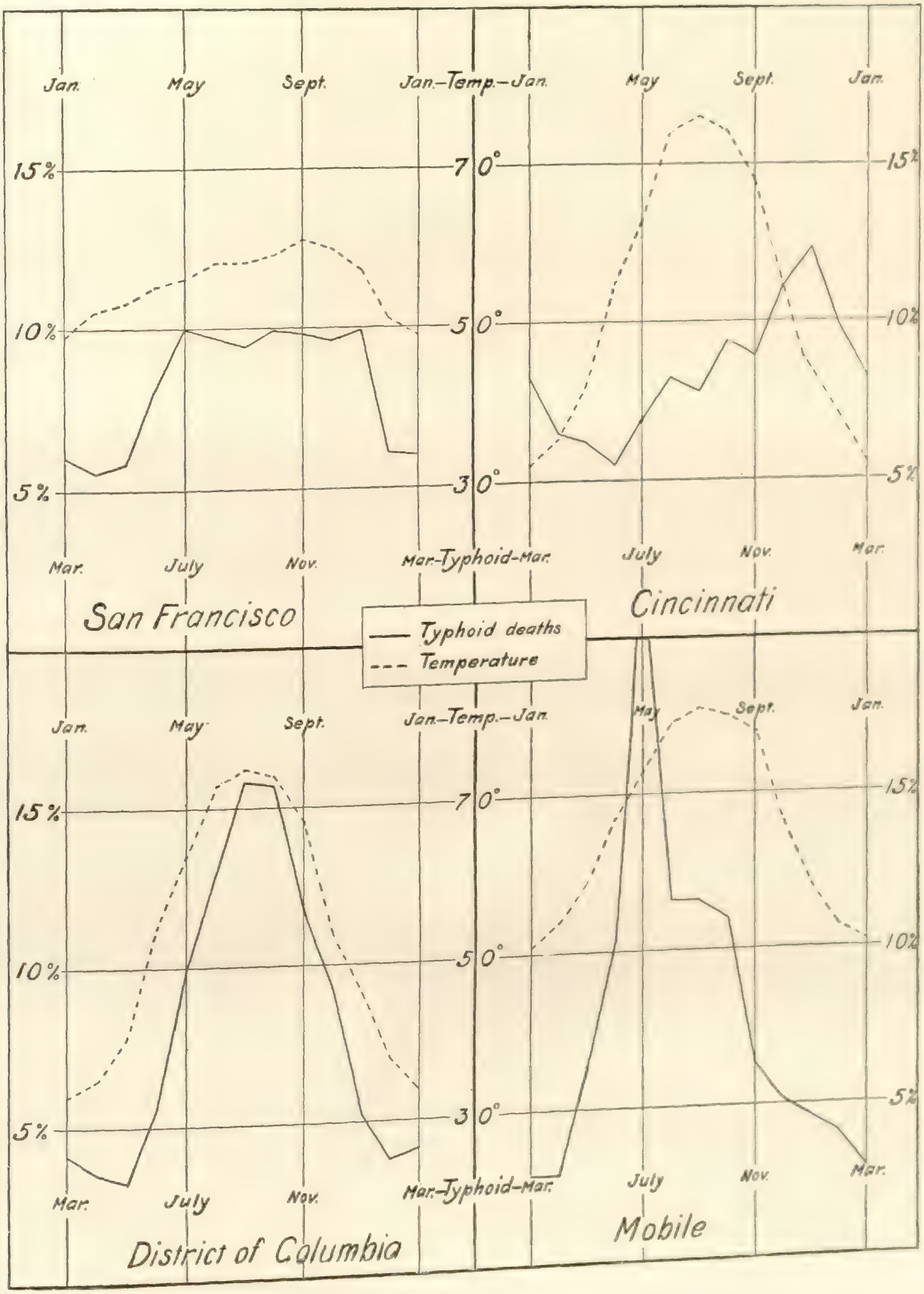

Jan.
May
Sept.
Jan.–Temp.–Jan.
May
Sept.
Jan.
15%
7 0°
–15%
10%
5 0°
–10%
5%
3 0°
–5%
Mar.
July
Nov.
Mar.–Typhoid–Mar.
July
Nov.
Mar.
San Francisco
Cincinnati
Typhoid deaths
Temperature
Jan.
May
Sept.
Jan.–Temp.–Jan.
May
Sept.
Jan.
15%
7 0°
15%
10%
5 0°
10%
5%
3 0°
5%
Mar.
July
Nov.
Mar.–Typhoid–Mar.
July
Nov.
Mar.
District of Columbia
Mobile

PLATE V.

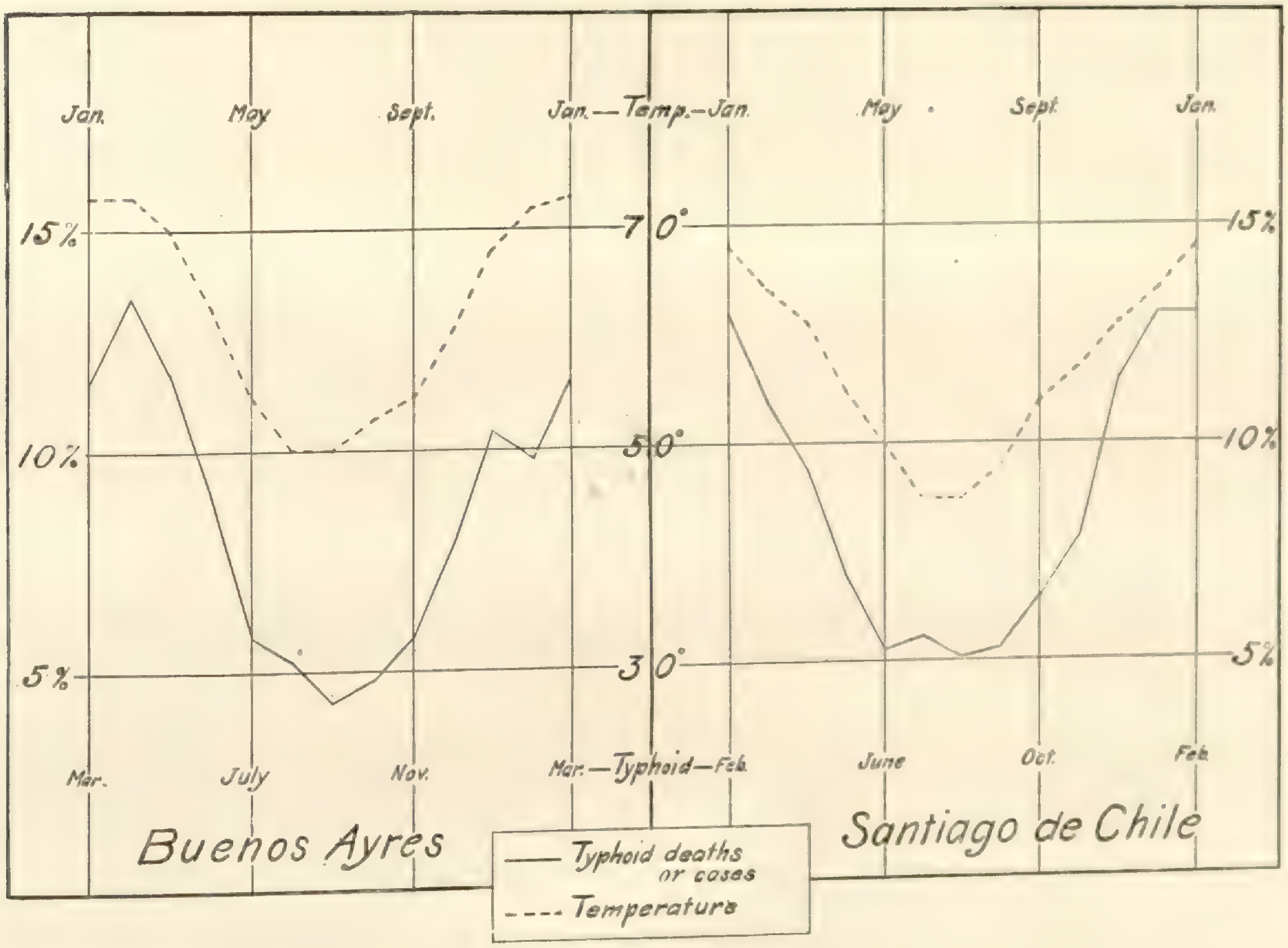

Jan.
May
Sept.
Jan.—Temp.—Jan.
May
Sept.
Jan.
15%
7 0°
15%
10%
5 0°
10%
5%
3 0°
5%
Mar.
July
Nov.
Mar.—Typhoid—Feb.
June
Oct.
Feb.
Buenos Ayres
Santiago de Chile
Typhoid deaths or cases
Temperature

PLATE VI.

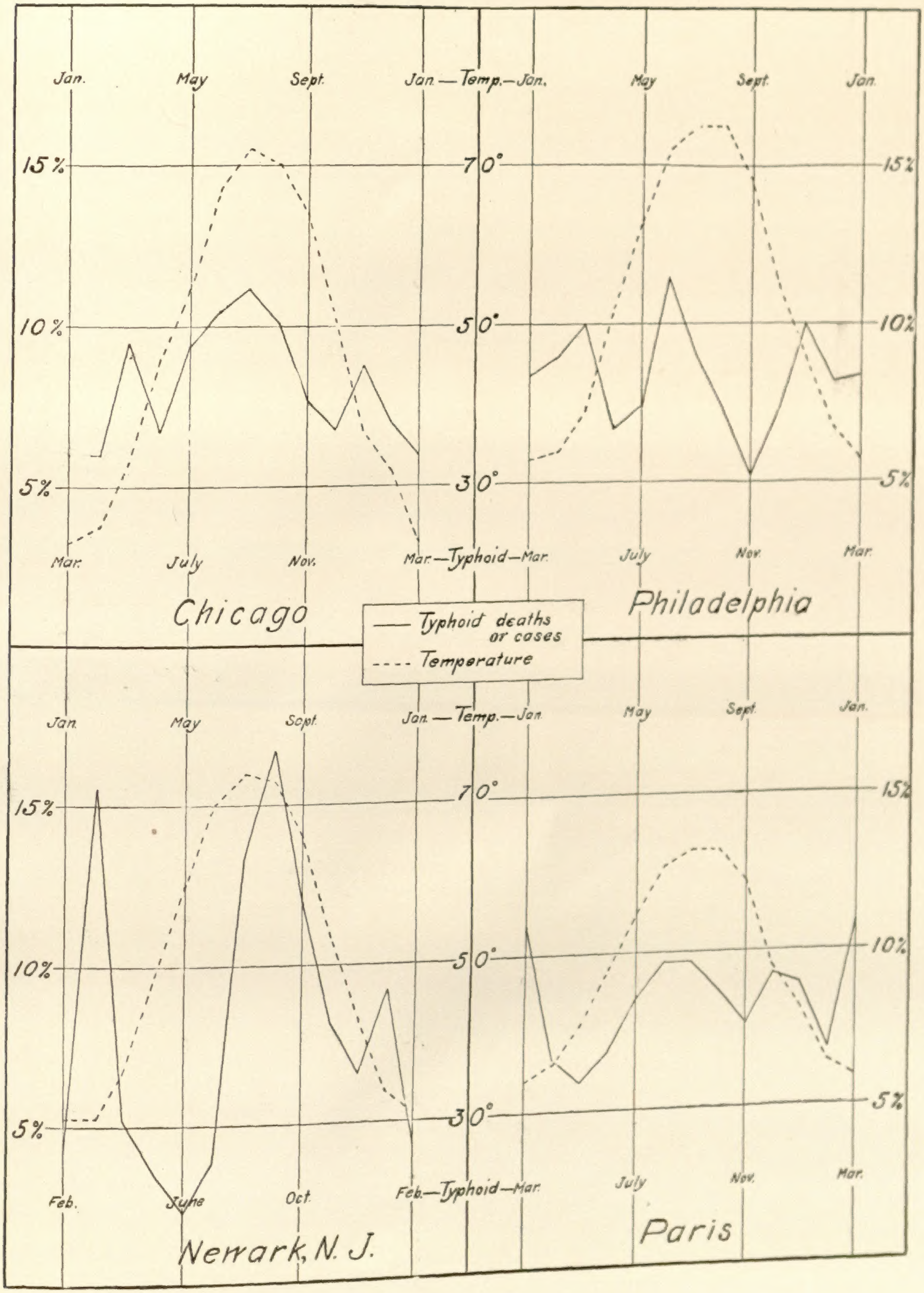
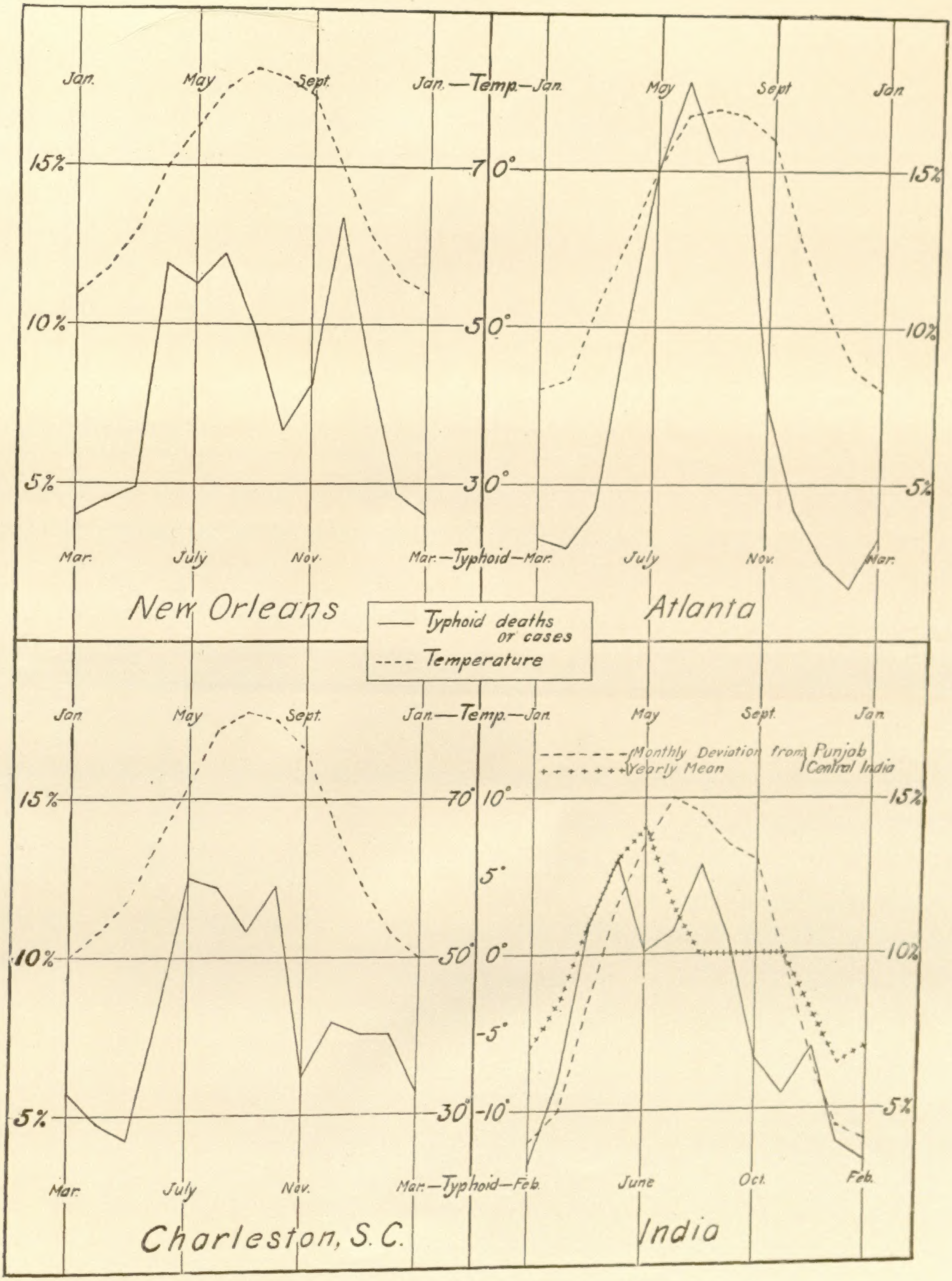
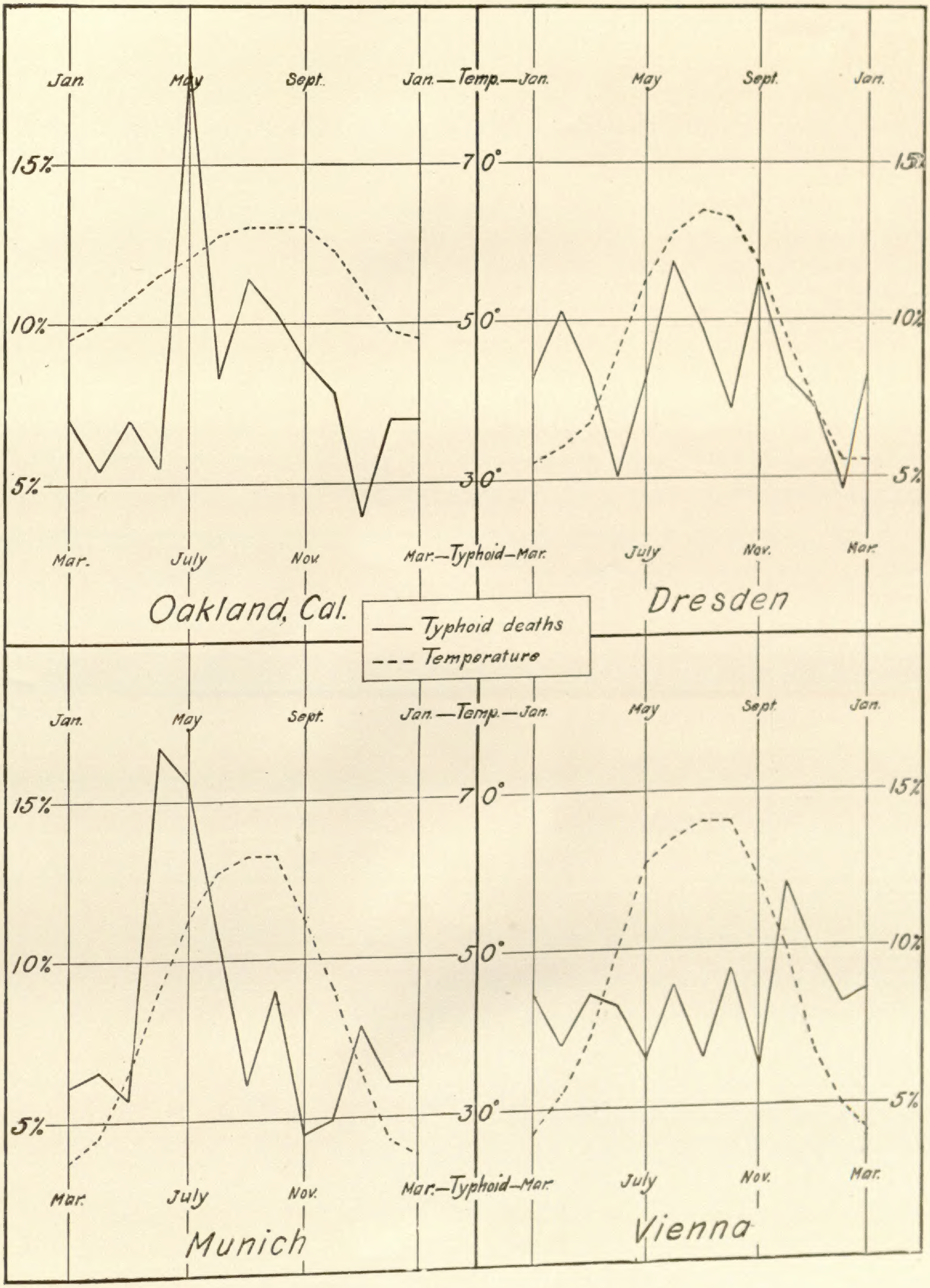

Chicago
Philadelphia
Newark, N. J.
Paris
—— Typhoid deaths or cases
- - - - Temperature
Jan.
May
Sept.
Jan. — Temp. — Jan.
Mar.
July
Nov.
Mar. — Typhoid — Mar.
Feb.
June
Oct.
Feb. — Typhoid — Mar.
15%
10%
5%
70°
50°
30°

PLATE VII.



New Orleans
Atlanta
Charleston, S.C.
India
Typhoid deaths or cases
Temperature
Monthly Deviation from Yearly Mean
Punjab
Central India
Jan. May Sept. Jan.—Temp.—Jan. May Sept Jan.
Mar. July Nov. Mar.—Typhoid—Mar. July Nov. Mar.
Jan. May Sept. Jan.—Temp.—Jan. May Sept. Jan.
Mar. July Nov. Mar.—Typhoid—Feb. June Oct. Feb.
15%
10%
5%
70°
50°
30°
10°
5°
0°
-5°
-10°

PLATE VIII.


Jan.
May
Sept.
Jan.—Temp.—Jan.
May
Sept.
Jan.
15%
70°
15%
10%
50°
10%
5%
30°
5%
Mar.
July
Nov.
Mar.—Typhoid—Mar.
July
Nov.
Mar.
Oakland, Cal.
Dresden
Typhoid deaths
Temperature
Jan.
May
Sept.
Jan.—Temp.—Jan.
May
Sept.
Jan.
15%
70°
15%
10%
50°
10%
5%
30°
5%
Mar.
July
Nov.
Mar.—Typhoid—Mar.
July
Nov.
Mar.
Munich
Vienna

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